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EDITORIAL

AN ISSUE THAT WILL NOT DOWN

BEYOND comparison more difficult to lay than Banquo's ghost is the everlasting question under what Departmental banner the forces of the Forest Service shall march. The question long antedates the existence of the Forest Service. It even antedates the 1891 law which was the embryo of the federal policy of public forest administration. It lifted its head in 1873. It looms again into prominence as the Seventy-Fourth Congress draws to a close.

It is unnecessary to linger long over the recent history of this ancient and troublesome issue. The salient facts are well known. Ever since President Taft succeeded President Roosevelt and Secretary of the Interior Ballinger succeeded Secretary of the Interior Garfield, the Department of the Interior and the Department of Agriculture have been in conflict, sometimes visible and sharp, sometimes smouldering, on federal conservation policies. Secretaries have come and gone, major engagements and multitudinous minor skirmishings have passed into history as won, lost, or drawn, but the chronic state of antagonism has never been supplanted by a state of real peace.

Superficially, the present phase of this struggle concerns jurisdiction—where the Forest Service, the National Park Service, the Soil Conservation Service, the Reclamation Service, the Public Land Grazing Administration, the General Land Office, and so on, shall be located. Theoretically, the question is how to get the best administrative set-up; realistically, the issue is an interdepartmental struggle for power; fundamentally, the question is not which Department shall have jurisdiction, but what policies shall govern.

In the years gone by, the two Departments have been arrayed against each other primarily because of profound disagreements on federal policies having to do with conservation. Initially the conservation movement was a movement to assert a public interest in the use made of the Nation's natural resources. It had two major objectives. One was to prevent an unnecessary waste and impairment and an eventual or premature exhaustion of our natural resources through exploitation solely for private profit. This was an economic objective. The other was to curb the building up of monopolistic control of the sources of wealth by concentrated capital as big business increased its economic and political power, and to seek diffused prosperity and economic independence for the little fellow—a social objective.

When the early conservation movement

reached its full flower—that is, as the first decade of the twentieth century neared its close—both these objectives blended into a more comprehensive one, the building of long-time national efficiency. That, to Theodore Roosevelt, required a Nation rich in resources well used for the public welfare and strong in a citizenship comfortably off, contented, and masters of their own destiny. Thus was sought the abundant life, plus corporate restraint and governmental control of economic development.

Naturally, these were very unpalatable ideas for those who held to the gospel of so-called *laissez faire*. At the time that Theodore Roosevelt relinquished the reins of government to his successor the feeling against him among the defenders of the old order was intense. Big-business partisans were almost *ipso facto* anticonservationists. Counsel for Ballinger in the Ballinger-Pinchot investigation gave vent to the emotions of a vast number of the Roosevelt opponents of his day when he declared that of all the bosh and drivel he had ever heard, this conservation twaddle seemed the most incomprehensible and silly.

By the time that Ballinger succeeded Garfield, forest conservation had become but a minor part of the field of battle. Most of the public domain timberlands had already been included in National Forests; though it remained to be seen whether they would stay there, or be reopened to private acquisition. The clash which displaced Pinchot and eventually Ballinger was precipitated on the issue of patenting the Cunningham coal claims in Alaska; and at the heart of that issue lay the question of Wall Street dominance of the resources and development of Alaska. The water-power issue, the issue of a leasing system for federal coal, oil, potash, and phosphate lands in lieu of passing them to private ownership, the issue of range conservation through regulatory control based on federal retention and administration of the public domain grazing lands, the issue of Indian lands policy, tied in. The transcontinental railroad interests had their stake in the game, played for economic dominance—and along with it and necessary for it, political dominance—of the far West. Monopolistic private control of natural resources brought to pass with governmental complaisance through a hand-out and hands-off policy—in other words, the continued rearing of the centralized structure of big business—had been challenged by the Roosevelt-Pinchot conservation objectives; and the battle was on all along the line.

Generally speaking, the advocates of the old order had on their side the Interior Department. One commonly given reason for this is the tremendous weight of Departmental tradition, viewpoint, and procedure. The Interior Department, while it comprised a miscellany of bureaus of diverse and largely of unrelated functions, stood out as the Land Department of the federal government, engaged in executing laws intended, with rare and unimportant exceptions, to get rid of the public domain. The accumulated momentum of an inveterate departmental purpose is not easily halted, even by a departmental head of other views—witness the difficulties encountered by Secretaries Garfield and Fisher and the small impression even these vigorous conservationists and administrators made on the permanent trend of their Department. A second reason for opposing public land retention was perhaps a persistent unwillingness to be reconciled with the passing to another Department of National Forest control, and a resulting disposition to lock horns with the Forest Service rather than to cooperate. A third reason is less often mentioned, but is highly pertinent in the present circumstances.

Because the Interior Department has been primarily the Land Department of the federal government, and because its land activities are almost entirely in the

far West, with rare exceptions the Secretary of the Interior has been a man from the West and acceptable to those politically the most powerful in the West. The great economic activities of the eleven so-called public land states are livestock production, mining and smelting, lumber production, and agriculture, the last chiefly either tied in with livestock production or concerned with specialized crops dependent upon irrigation. In the first three, the dominating power is the interest of large capitalists and their followers and sympathizers. With them, of course, is associated the powerful interest of the railroads. Often the strings of control—and the conduits through which flow most of the stream of profits for final distribution in dividends—end in the great financial centers of the East. Political forces being what they are, it has been inevitable that in the long run and for the most part the selection of the Secretary of the Interior Department and the Commissioner of the General Land Office should have been determined by the viewpoint of those who wish to be as free as possible of governmental controls and as free as possible to obtain and exploit the resources of the public lands from which money can be made.

Now the picture is suddenly changed, at least for the present. The old Interior Department has been infused with fresh vigor. It had become, as the process of alienating or permanently reserving and administering the lands of the public domain advanced, a Department of diminishing activities. But there is nothing moribund where Secretary Ickes governs.

Like a bombarded atom, the old organization has been invaded by an external energy, and is undergoing transmutation. The vast addition to its office capacity that is being made as the walls of its overflow housing go up testify to the rejuvenation. In laying the cornerstone of the addition (which occupies the space of two full city blocks), President Roosevelt gave encouragement to a thought suggested by Secretary Ickes regarding the possibility that his Department was "to be rechristened by the name that we would be so proud to bear, the Department of Conservation." A month later Secretary Ickes gave a radio address on "Conservation," which began:

"Three days ago there was passed by the United States Senate a bill to change the name of the Department of the Interior to that of Department of Conservation. This bill has now gone to the House of Representatives, where it is hoped that it will receive early consideration."

Later in the same address, Secretary Ickes said: "It is my opinion that conservation can only be established on a sound and permanent basis by adopting it as a national policy and concentrating the administrative responsibility in a single agency. . . . In undertaking to have the name of the Department of the Interior changed to that of the Department of Conservation by Congressional action I have been endeavoring to meet this need."

Presumably it will remain for the next Congress to determine whether, after its long life in the Department of Agriculture, the Forest Service is to be transplanted to a new environment and undergo the changes which would necessarily follow. That is a question which it behooves all foresters to ponder carefully. The practical consequences must be weighed; but that must be reserved for discussion in a later JOURNAL.

THE C.C.C. IN GERMANY[1]

By ARTHUR C. RINGLAND

In some form or other many European states have developed organized labor services as a constructive means of assistance to the age classes most critically affected by the post-war economic and social crises. Bulgaria, it is believed, established the first of such services, shortly after the close of the World War. It was made compulsory, and to that degree was a substitute for military conscription, forbidden by treaty; nevertheless, its purposes and work were and remain wholly constructive.

In 1932 Germany established the Voluntary Labor Service, and rapidly recruited over 200,000 workers. Our own C.C.C. was yet to be organized, although volunteer labor camps were in operation in California. The German experiment was so successful that the Service became virtually compulsory for both young men and women, by the passage of the Labor Service Act of June 26, 1935. It is popular, and is now accepted as a national institution; a cornerstone in the reconstruction of the country and of the people. While the Labor Service is compulsory for both sexes, the organization for young women is still in the formative stage.

The German Labor Service means much more than a temporary device for combating the present evil of unemployment. Broadly speaking, the objectives are of long range, social and economic. It is the intent to unite the youth of all classes in common, hard, and honorable work for their people and country; to foster a general love of order and cleanliness; to awaken in youth the spirit of honor, discipline, and comradeship; to teach a new conception of work and to impress the younger generation with a proper esteem for manual labor; to develop a sense of civic responsibility. To the natural German love of esprit de corps, there is added a powerful, conscious educational program aimed to indoctrinate these youths with the philosophy of national unity. On the walls of the mess halls there were hung slogans—"Germany needs you; you need Germany"—"The Work Service is the Honor Service of German youth".

Since the time of Frederick the Great and the public works he inaugurated following the Seven-Year War, there have been no improvements of the soil on a national scale; therefore, one of the primary objectives of the Labor Service is the execution of projects to serve the common public welfare—the reclamation of the soil through agricultural and silvicultural development; the drainage of moors and the utilization of sterile lands; the recovery of new lands; drainage and irrigation; regulation of rivers and torrents; construction of storage dams and fish ponds; suburban and rural resettlement—the first to draw surplus labor from metropolitan areas and decentralize population, removing the city people

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[1]Based on extracts from "The National Labor Service," by Dr. Kurt Stamm, "The Spirit of the Labor Service," by Col. Hierl, "Objective and Meaning of the Labor Service," by A. Krugen, and "Education and Selection in the National Labor Service," by Paul Seipp; Hamburg World Economic Archives; and observations of Mrs. Wm. Christian, American Council of Education, in Germany (1931), W. N. Sparhawk, U. S. Forest Service, in Germany (1935), and the writer in Bulgaria (1922) and Danzig Free State and Germany (1932). The notes from the four first-named works were translated from the German by Dr. A. H. Krappe, of the U. S. Forest Service.

from the slums to the outskirts of cities, where they may own their own home and garden; the reforestation of waste lands; reconstruction of private forest lands damaged by wind, insects, and fire which cannot be fully met by private expense; timber stand improvement, and the establishment of game preserves; construction of roads for better forest utilization. The objectives of the forestry projects are: to increase the timber crop in order to reduce importations and cheapen transportation costs; to furnish construction timber, pulp, and raw material for the rayon industries; and to curb floods and droughts and promote playgrounds for city populations.

The selection of projects of the types described must serve the public welfare. It is, too, the policy of the Labor Service to promote projects which cannot very well be handled by the unemployed at their places of residence. The Labor Service does not entail additional expenditures for the state, for it means utilization for the state of the unemployed who formerly lived on the unproductive dole. There is no dearth of work, and there are enough projects to keep 500,000 men busy for the next 20 years. The ultimate objective is to produce a greater independence of German national economy.

The Labor Service has an authorized strength of 200,000 men on the average, including officers. The Reich Chancellor determines the number of recruits to be called each year, and fixes the duration of their service. Recruiting is twice a year—in April and October. Young men who enter at 17 must stay a year; those who enter after the eighteenth birthday serve for six months, and remain longer if they wish. University students, before graduation, must spend six months in the work camps, and employed single men between the ages of 18 and 25 must give up their positions to married men for the duration of the service. Service usually begins upon completion of the eighteenth year, but young men are subject to one period of duty until they have completed the twenty-fifth year. Volunteers may enroll at the age of 17. It is the evident intention of the government to reduce gradually the spread of the age classes to the minimum ages, in order that there may be the least interference with vocational careers and adjustment to adult life.

Physical or mental defectives or social delinquents are not permitted to enroll. The time of conscription may be deferred for two years in individual cases because of professional exigencies. Volunteers and conscripts may be discharged at their own request if for professional reasons they desire a postponement of their service; or when they no longer possess the qualifications necessary for a satisfactory discharge of their duties.

Uniforms, rations, and quarters are provided; also medical service and compensation for injury. Wages have not (in 1935) been definitely fixed; in the old Voluntary Labor Service enrollees received pocket money roughly equivalent to the monthly cash allowance ($5) of the American C.C.C. enrollee. Discipline is based upon the regulations of the civil service. At work the enrollees wear gray denim like the blue denim of our C.C.C., and when the weather permits the boys work, like ours, stripped to the waist. The dress uniform is quite smart in contrast to the C.C.C.—high leather boots, gray-green uniform with black leather belt, black shoulder tabs, and visored cap.

The Robert Fechner of the National Labor Service is Colonel Constantine Hierl, a World War veteran; he has the title of "National Labor Leader". In fact, the title "Leader" in varying degree is carried down to the lowest grade of officer. These officers rank as government officials and are subject to the regulations of the civil service; they are recruited

The march to a new project.

from all ranks and classes of society. A candidate for the grade of officer must obligate himself to an interrupted service of at least 10 years, and he must have started his career in the corps as a simple worker. The decisive elements for promotion from the ranks are the ability of the candidate, as developed in special training schools, and his individual merit and personality. He must, too, have served in the Army and Navy. Regular retirement occurs automatically at a given age.

The career service is open to all, and to the highest grades. It comprises three divisions—Lower, Medium, and Superior, adapted to the educational qualifications of the candidate. The Lower grade ends as a rule with the title of "Senior Crew Leader", about comparable to our Army sergeant, although for exceptional service the rank of our top sergeant may be reached. The Medium grade corresponds to our junior Army officers, that is, ending with the equivalent rank of captain. The Superior grade corresponds to that of our Army field officers, beginning with the equivalent rank of major. Candidates with a diploma from an institution of higher learning may be certain of promotion to the equivalent of a lieutenant's rank after satisfactory duty in the Labor Service and after equally satisfactory completion of their military duties.

The general administration of the Labor Service is organized in divisions, in charge of superior officers. The Administrative and Economic Center deals with policy, organization, and finance; the General Service Center, with supply; the Planning Center, with the planning and coordination of the work projects; the Personnel Office, the Office of Education, the Health Service, and the Office of Press Relations, with the fields indicated by their titles.

The country is divided into 30 labor districts; each district is in turn divided into a number of groups, and each group into divisions. A division comprises at least one camp of 152 men, including overhead. The company consists of 3 platoons, and each platoon includes a crew of 15 men. The supervisory personnel consists of about 20,000 officers.

The new camps are in nearly all respects quite like those of the C.C.C. although perhaps not as elaborate. The barracks are prefabricated, and are erected and dismantled by enrollees. Sometimes, when the projects are not isolated, old factories or other buildings are used. Often the camps are made particularly attractive by flower beds, window boxes, gravel walks, and fencing. The daily schedule is quite similar to ours, and is as follows:

6:00 a.m. (in summer 5:00 a.m.). Reveille.
6:05 a.m. to 6:20 a.m. Setting-up exercises.
6:20 a.m. to 6:40 a.m. Washing, making up of beds and care of barracks.
6:40 a.m. to 6:55 a.m. First breakfast.
7:00 a.m. Roll call; departure for work.
Six hours work in the field.
2:00 p.m. Return from work.
2:30 p.m. to 3:00 p.m. Dinner.
3:00 p.m. to 4:00 p.m. Rest Period.
4:00 p.m. to 5:00 p.m. Recreation and sports.
5:00 p.m. to 6:00 p.m. Lectures and academic instruction.
6:00 p.m. to 7:00 p.m. General orders, instructions, cleaning, roll call.
7:00 p.m. Supper.
8:00 p.m. to 9:00 p.m. Amusements (community singing or games).
9:45 p.m. Tattoo.
10:00 p.m. Taps.

Ordinarily the men march to work and in formation, but bicycles are used when the work is distant.

The men march to the work. The love of marching and singing is so much a part of German tradition that the work soldiers, for that is what they are called, never go to work without marching, and never march without singing, carrying their spades like rifles. If the work project is at some distance from the camp, the men ride bicycles and in formation.

As a rule, work projects are undertaken only in cooperation with public bodies—national, state or municipal, or a public or semi-public corporation. It is considered that only these organizations afford satisfactory guaranty of proper maintenance. There are certain departures from this policy, as in the case of private forests damaged by wind, insects, disease, or fire where restoration costs are too great for the private owner.

The work which the Labor Service performs must be additional, i.e., of a character which would not normally be carried out by established public authority in the current fiscal year or in the year immediately following. Compulsory work that has to be undertaken by public authorities in any case cannot be regarded as additional. No considerable quantities of material must be required for Labor Service projects. The work must not involve the use of machinery. It must be possible of performance by persons who in the main are not normally employed in it, and of a kind that can not very well be handled by the unemployed at their places of residence. It must benefit the community, i.e., either the entire nation or a majority of citizens must derive advantage from it. This condition is considered fulfilled if the order for the work concerned originates from a public or semi-public corporation. The work must be economically valuable. Generally speaking, this condition is regarded as satisfied if the work concerned is remunerative in the sense this term is used by economists, i.e., the work must be of productive utility to the body economic, either directly or indirectly.

The categories of work given in the forepart of this article, such as soil improvement, waterway regulation, afforestation, and resettlement, usually fulfil the conditions enumerated. If such work is of any use to the national economy at all, it is of direct use to it, and may therefore be carried out by the Labor Service provided that a careful examination of the projects proposed leads to this conclusion. Projects such as these are supplemented by those which are of use to the national economy in an indirect sense, more particularly those intended to improve the national standards of health and those connected with emergency relief.

Petitions for approval of projects must be submitted by public authority to the District Board of the Labor Service. The Board obtains the expert judgment of designated authorities, such for example as a State Office of Works for land reclamation projects, the Provincial Chamber of Agriculture for soil projects, the State Forest Service for forest work, or in resettlement projects the provincial resettlement associations. The District Board submits its report for approval to the National Board of the Labor Service, together with a map on the scale of 1: 25,000 and the experts' estimate of the economic value of the project and the costs. The approval of the National Board of the Labor Service is necessary before a project can be started.

Projects are carried out by contract wherein, under certain conditions, general for all projects and specific for particular projects, the Labor Service agrees to do the work. These contracts represent the essential basis for the use of the manpower of the Labor Service, and regulate uniformly the obligations, rights, and duties of each of the contracting parties. The cooperator is obliged to make a contribution to the project unless specifically

The barracks are prefabricated and are erected by the enrollees.

exempted by the National Labor Board. This contribution must be made in kind, in cash, or in both. These contributions cover in particular: (1) provision of lodging or barracks, including sanitary facilities, according to specifications of the Labor Service; (2) provision of lighting and water supply, including fuel for heating and cooking purposes; (3) transportation of officers and men from the lodging to place of work whenever this is more than 1½ hours distant by marching; (4) supply of tools according to the model types of the Labor Service, including upkeep of such tools; and contribution for social insurance. The cooperator must provide at his expense the equipment required for the type of work expected, in sufficient quantities and proper condition, whenever a cash contribution for their supply and upkeep is not furnished. He must, too, supply at his expense the materials required for the proper execution of the work, and is responsible for their satisfactory condition. Under certain conditions the payment of salaries of the technical experts and of the necessary supervisory personnel is incumbent upon the employer. Upon completion of the work, the property of the cooperator must be surrendered by the Labor Service in proper condition, with due allowance for depreciation, and the Service is responsible for all property damaged or for loss by reason of negligence. The hours of duty must not exceed 36 a week of actual work, and not more than 45 hours including time consumed in transportation.

A contract may be canceled if one of the parties does not comply with its obligations within two weeks of date of written notice of violation; or it may be canceled by the Labor Service if this is necessary in the interest of the state. Disputes are settled by arbitration. A detailed plan of the project accompanies all contracts, giving estimated costs and a computation of volume of work in terms of man-days, together with surveys and maps and a detailed description and working plan of the project. The supervision of the work is incumbent upon the Labor Service, and of technical matters upon the state authority having jurisdiction. The work must be jointly surveyed at regular intervals by the cooperator and the Labor Service. Completion of the work must be certified by the cooperator at the request of the Labor Service. If no certification is given by the cooperator, the work is considered certified at the end of 10 days after written notice from the Labor Service of the termination of the project.

It will be seen that in many respects the German organization parallels our Civilian Conservation Corps. But there are a few notable exceptions. The German Service is permanent and virtually compulsory; work projects are undertaken only with public bodies, and on a cooperative and contributory basis preceded by expert appraisal and conditioned by contract, and following detailed working plans; the supervisory personnel is recruited from the ranks after completion of training in special schools; it is a career service for the personnel of all supervisory grades, and under civil service regulation. Public opinion in America generally supports the thought of a continuing C.C.C. Should a permanent organization be undertaken, we can well profit by adopting some of these principles of the German Labor Service.

TWENTY YEARS OF SLASH PINE

By WILBUR R. MATTOON

U. S. Forest Service

Two decades ago slash pine was almost unknown in respect to its younger or future management aspects. It was not commonly recognized but often confused with longleaf or loblolly pines. In this paper the author describes its development from that stage to its present important position in forest management in its native region and its possibilities for extension elsewhere.

TWENTY years ago little was known regarding slash pine (*Pinus caribaea*) as a tree for forest management. Except in North Carolina, there was no state forestry organization in the South; the federal Forest Service had very limited data on the growth and volume of virgin "Cuban" pine, as the tree was then called; and brief notes in Mohr's "Timber Pines of the Southern States," published in 1896, constituted the only known reference in literature to second-growth.

The earliest silvicultural investigation of second-growth slash pine was made by the author in the spring of 1916, while on a 3-months' field trip originally undertaken to study second-growth longleaf pine from North Carolina south to Florida and west to southeastern Texas. In Hardeeville, Beaufort County, S. C., a very different pine was met, especially different as to its second-growth characteristics—vigorous, straight, with small branchlets and long, dark green, lustrous leaves of 2 or 3 in each bundle. The tree made an immediate and deep impression. It was soon recognized as slash pine, on the basis of observance of similar young pine first found and identified in or near the Okefinookee Swamp in 1913. During the rest of the trip growth and yield studies, including measurements, were made in equal amounts on second-growth longleaf and second-growth slash pines.

It may be noted in passing that by coincidence Hardeeville, S. C., was where Roth, as an assistant to Mohr, made extended studies of virgin "Cuban" pine. On a later visit the author met a number of people who well remembered the "Yankee who was so enthusiastic over pine trees." The large, particularly fine trees of slash were locally known as "rosemary" pines, a name, however, which is equally applied in other sections to similarly large clear trees of shortleaf or of loblolly.

As the author's trip in the spring of 1916 progressed, favorable points were noted for later making more detailed observations and measurements. Incidentally, the town of Homerville, Ga., was marked on the field map as the "center of gravity of slash pine." On the way back from Texas the last of May, a more intensive study was made at a few selected points, including southeastern Georgia west from Savannah for 100 miles along the Seaboard Airline Railway to the limit of slash in Telfair County, but more intensively in Columbia and Baker Counties of northeastern Florida, now located in the heart of the Osceola Division, Florida National Forest. In this latter region the study was particularly facilitated by the fine cooperation of the Paul Brothers of the East Coast Lumber Company, located in Watertown, near Lake City in northern Florida. This concern was then logging large amounts of virgin slash along with virgin longleaf pine. There was little if any thought on their part of any future for pine.

The field study was completed on June

30. During its last month the author had the assistance of C. R. Tillotson, who then as well as in later investigations proved very helpful. The data obtained formed the basis for working up the first growth and yield tables for second-growth slash pine. These were available in the late fall of 1916.

The author's impressions regarding the occurrence and promise of slash pine for silvicultural management, as formed during the 1936 trip, were expressed in an article[1] from which the following passages are quoted:

"Slash pine is fast replacing longleaf pine over portions of the coastal plain of the South, as loblolly is doing in the northern part. Intrinsically it is a better tree than longleaf. Its growth is more rapid, its wood heavier, harder, and stronger, and its yield of crude turpentine larger and of a better grade. The chief causes for its spread are clearly its frequent and abundant seed production, very rapid growth, tolerance, ability to withstand the combination of both hogs and fire, and capacity to adapt itself to a wide range of environment. It appears to have in a high degree the necessary qualifications for being handled on a large scale under approved methods of silviculture."

"The South, with its millions of acres of land too poor to be of agricultural value for a half century at least, is gradually giving attention to the economic question of putting its unused lands to their most profitable use. In this connection slash pine stands out as a tree of very high commercial value."

Earliest Planting and Seed Sowing

During the spring field study in 1916 in Columbia and Baker Counties, Florida, thickets of sturdy slash seedlings with straight, stocky stems from 8 to 14 inches in height were frequently observed in low moist places such as the edges of slash-cypress ponds. Some time about the second week in June, the author dug 50 of the seedlings, then one year old, and shipped them by parcel post to the Clemson Coastland Experiment Station, near Summerville, S. C., where for several years he had been conducting experiments for the Forest Service in cooperation with the Clemson Agricultural Experiment Station, to determine if possible the most practical methods of securing satisfactory stands of young pines on cut-over longleaf pine land. The trees were received and planted by the superintendent, with the astonishing result of a 50 per cent survival in spite of their having been dug, shipped, and planted in very hot weather in the midst of the growing season. The conclusion was clear that young slash possessed unusual vigor, and therefore was well adapted for planting.

Most of this plantation was unfortunately destroyed during the second year; the remaining stand was thinned about 1920. In the fall of 1928 the 14-year-old trees averaged 40 feet in height and 10 inches in diameter, and bore a cone crop with pulp seeds. (Fig. 1.) In March, 1936, when 21 years old (from seed), the trees averaged 55 feet in height and 15 inches in diameter. These are the first known forest-planted slash pines in the United States.

Another result of the study was the earliest known bulk slash seed collection, seed distribution, and seed sowing for reforestation purposes. In the fall of 1916 70 pounds of slash pine seed were collected for the Forest Service for the purpose of extending the study of the adaptability of slash for reforesting southern cut-over lands. The seed was gathered by M. Brownie Wilder of Lake City, an employee of the East Coast Lumber Company, who had been very cooperative in

[1]Mattoon, Wilbur R. Slash pine—an important second-growth tree. Proc. Soc. Am. Foresters 11: 405-416. 1916.

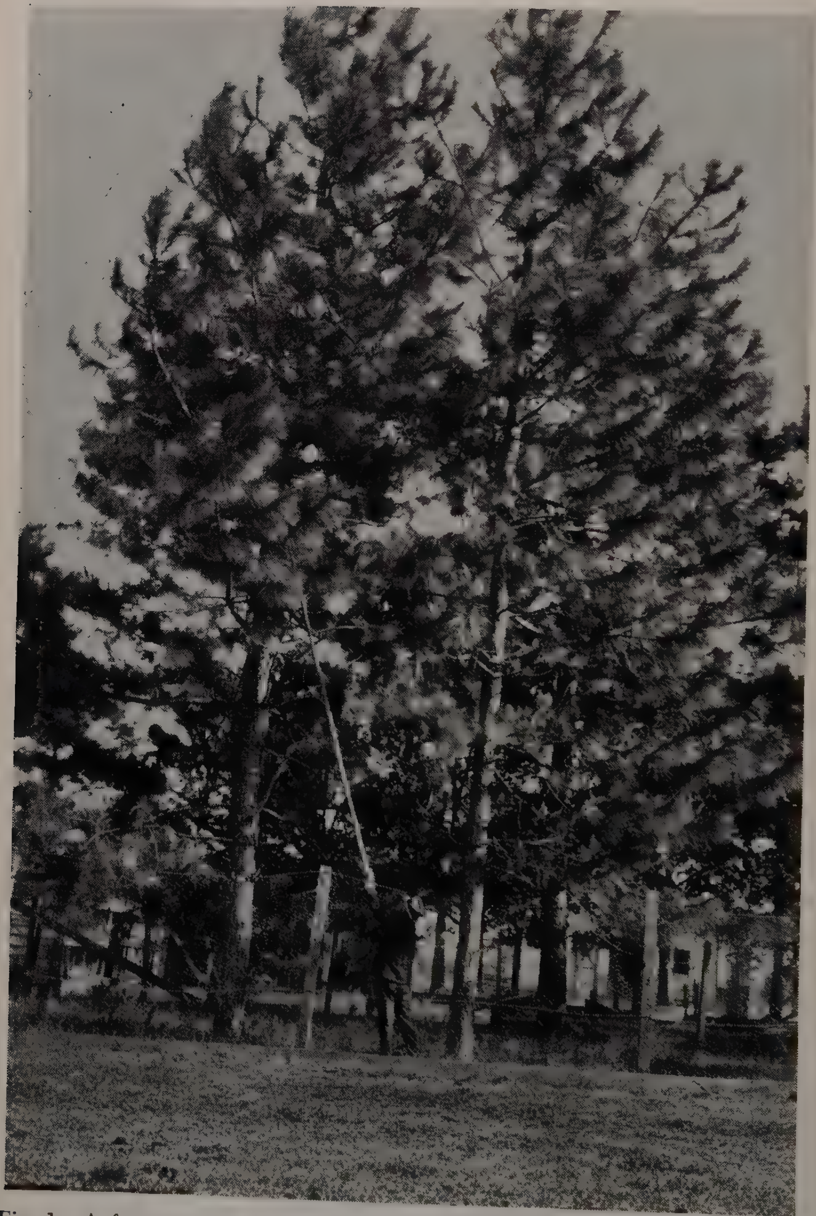

Fig. 1.—A few trees of the first known forest plantation of slash pines, made at Clemson Coastland Experiment Station, Summerville, S. C. As shown here, 14 years old (from seed). Average height 40 feet; average d.b.h. 10 inches.

the making of growth studies the previous June. His name is included here because of the fact that during the following decade or more, as the demand grew for slash seed, he came to be relied upon for collecting seed true to species, of high grade, and in any desired quantities. The species itself at that time was not popularly recognized. Moreover, trees of slash and loblolly pines have several points of resemblance and the seeds of the two species are difficult to distinguish, often resulting in lots of mixed seeds.

The 1916 seed was distributed rather widely for purposes of test sowings in nurseries. The recipients included the Georgia Forest School of the University of Georgia, then the only forest school in the South, various state agricultural experiment stations, the land department of the Great Southern Lumber Company, and foresters or nurserymen in several foreign countries, including France and Japan. Through contact with a local commercial seed company in Atlanta, Ga., its interest was obtained in commercially handling slash seed.

Direct Seeding

Significant is the first known field sowing of slash pine. Experimental sowings of seed of longleaf, shortleaf, loblolly, and French maritime pine at the Coastland Experiment Station near Summerville, S. C., from 1912 to 1916 had given results ranging from failure to very poor. The problem of establishing young growth on cut-over longleaf pine lands had not yet been solved. On April 26, 1917, slash pine seed from the 1916 seed crop was sown by the author in freshly hoed spots in old furrows at the Experiment Station, where previous sowing of another species had failed. The spacing was 6 by 6 feet. The seeding was successful. This was followed by an elaborate series of experimental sowings in November, 1917, and a duplicate series in March and April, 1918. Credit for this plan is due C. R. Tillotson, who also made the fall sowings. The spring sowings and others in 1921 and 1922 were made by the author. The results have been variable, but all have been good, and most of them have been eminently successful. This statement, as will be generally recognized, is significant.

In 1923 and 1924, while promoting farm forestry extension work in South Carolina and Georgia, the author made some 10 different direct seedings on farms and at agricultural high schools. Examination up to 4 years afterward showed good average results, and no failures. However, most of the stands are known to have been destroyed later by woods fires, then everywhere prevalent, in spite of individual owners' efforts to protect their lands. The Great Southern Lumber Company of Bogalusa, La., has a fine stand of 6 acres of slash pines from seed-spotting in furrows in the winter of 1920-21, the first commercial seeding of slash in the United States. These results warrant the conclusion that fair to good results may be expected from sowing, either broadcast or in seed spots, about 2 pounds of good slash pine seed per acre on low poorly drained or "crawfish" land, such as occurs in vast areas in the flatwoods, or from sowing seed in well prepared furrows, especially in old fields. In this respect slash stands in a class alone among all the southern pines, and practically among all native pines.

In spite of this conclusion, the method of direct seeding of slash is not to be widely recommended, but instead the planting of one-season-old nursery-grown seedlings. Slash seedlings can be easily and cheaply grown, reach sizes up to 8 to 12 inches in height in one season (usually without watering), and attain unusual vigor. Slash is an abundant-seeding species. Planted stands possess

decided points of advantage over those from seed-spotting or broadcasting in respect to even spacing, uniformity of original stand, and absence of need for early thinning.

Slash Pine Plantations

The earliest known forest planting, that of 1916, has been described. The period of real consciousness of the merits of slash pine as a tree to be planted for the production of timber and turpentine dates from 1920, when the Great Southern Lumber Company began its vast reforestation program by actual work on a commercial scale. In 1916, while making the reproduction and growth study, the author discussed with Colonel W. H. Sullivan, then general manager of the Company, what he had learned about slash pine as found growing luxuriantly from Slidell northward to Bogalusa. In the following spring (1917), he furnished some slash seed to the Company with the suggestion that it be tried out in a seed bed at the Company's "demonstration farm." Practically all of the larger lumbering concerns then maintained such farms as show places to prove to prospective purchasers what the lands could produce.

Then in the winter of 1918-19 along came Austin Cary. Thereafter he made periodic visits to the Great Southern and other large companies. His influence must always be reckoned with in connection with the expansion of southern forestry that started approximately in 1920, when the Great Southern Lumber Company launched out on a program which endured. The earliest known commercial direct seeding was by the Company in the winter of 1920-21, when 6 acres were seed-spotted. The first known commercial planting was likewise by this company, the following winter. During the next 10 years, by planting trees and by a little direct seeding on heavily denuded cut-over lands, the Company created a magnificent young forest of 30,100 acres, of which 14,506 acres, or about 45 per cent, is slash pine. Longleaf occupies 8,600 acres, or 27 per cent, all planted; loblolly, 6,100 acres, or 25 per cent, planted, and 800 acres, or 2.6 per cent, sowed; and shortleaf, 20 acres planted. A typical operation is the Peters Creek plantation of 900,000 one-year-old slash seedlings in a 1,000-acre block, with a spacing of 6 feet apart in furrows spaced 8 feet apart; it was made in the winter months of 1925-26. A view of the resulting stand is shown in Figure 2.

Approximately at the same time, the first conscious efforts to manage natural stands of slash were made in southern Georgia—center of the natural range of slash pine. Various companies came into being—for example, the Timber Products Company at Cogdell (near Waycross, Ga.), and the Superior Pine Products Company, with headquarters at Fargo, Ga. These companies now have holdings amounting to about 60,000 and 204,000 acres, respectively, and although longleaf with some cypress and gum is prominent, the operations are based primarily upon slash pine managed for naval stores production.

It has been noted that in 1916 the author marked Homerville, Ga., as the "center of gravity" of slash pine. As it happens, Homerville lies about midway between the two above-mentioned headquarter towns. The mental picture of the region obtained by the author at the time of the 1916 study led him frequently to say that if he had capital with which to acquire a few thousand acres of second-growth slash and worked it carefully by eliminating fires and applying conservative chipping, he would eventually be in a position to "sit on the front porch dressed in white duck and smoke long cigars the rest of his life." During the two years following the study no one confirmed the author's belief in the silvicultural possibilities of slash pine. Austin

Cary was the first person to express any confirmatory opinion, in May of 1918, at the time of his return from his first trip South.

During the period from 1920 to 1925, before there was much planting in the South except at Bogalusa, La., forest planting of slash pine was well under way in parts of Australia, South Africa, and New Zealand. More seed was shipped abroad than was used in this country. Planting in south Georgia to establish turpentine "orchards" began about 1926, and has since been done extensively. A good example of commercial planting of slash pine in South Carolina is one by the Southern Railway System made in the management of its 10,000-acre forest, as shown in Figure 3. In the fall of 1935 the Forest Service obtained 7,915 pounds of slash seed for sowing in its nurseries. The total collection in 1935 is estimated at between 30,000 and 40,000 pounds. A pound of slash averages 15,500 seeds. Seedlings are now being grown extensively in nursery beds by nearly every southern State Department of Forestry from South Carolina to Louisiana, and in quantity by such federal agencies as the Forest Service and the Soil Conservation Service. A rough estimate indicates a total of some 15 to 20 million slash pine seedlings planted by all agencies in the winter and spring of 1935-36.

Extension Beyond Natural Range

Interest slowly grew in planting slash pine within its natural range, namely the coastal plain from South Carolina nearly to the Mississippi River in Louisiana. Then other states began trying it out beyond its natural range. In the early '20's the outstanding example was at the Georgia State College of Agriculture at Athens, Clarke County, where trees from the 1916 lot of seed were sown in the spring of 1917. They were in stiff red clay 100

Fig. 2.—Part of the Peters Creek plantation of slash pine at Bogalusa, La. Trees 7 years old (from seed), height 18 to 24 feet.

Fig. 3.—Ten-year-old slash pine planted in spring of 1926 by the South Carolina Forest Lands Operation (Southern Railway System) in Dorchester County, S. C. Total age from seed is 11 years; height 30 to 35 feet; diameter 6 to 9 inches.

miles north of the natural northern range and at a higher elevation. The trees when measured in 1923 had commonly made annual height growths of 30 to 40 inches and a maximum of 53 inches in one year. Outside of this, among the earliest test plantings and sowings were those made in various places under direction of the author while doing extension forestry work in South Carolina and Georgia, in the fall of 1923. An acre planted in the spring of 1924 on the Boy Scout Tract near Macon, Ga., has grown vigorously and aroused much interest; this location, however, is only about 50 miles north of the natural range of the tree. A plantation and a seed spotting of slash made in 1925 at Clemson Agricultural College in northwestern South Carolina has been successful on worn-out uplands high in the Piedmont, at an elevation of 800 feet and 140 miles north of the nearest natural growth. Here slash has far outstripped in growth the native shortleaf, and as yet has suffered no injury from sleet, one of the factors most likely to be detrimental in colder climates. A few slash pines planted along with loblollies at the State Agricultural Experiment Station at Statesville, Iradell County, N. C., in the middle Piedmont region, have made a fine growth. These are 225 miles distant from the nearest slash in southern South Carolina. In November, 1935, some slash pines planted in the spring of 1929 at the state forest nursery near Jackson, Tenn., measured mostly from 14 to 18 feet in height and from 2 to 4 inches in breast-high diameter. They were planted by R. S. Maddox, State Forester at the time, who states that the plantation was made in hard sterile clay soil on a hillside, with a minimum of soil preparation, purposely to see what might be expected from similar plantings done carelessly by land owners. The height growth averaged around 2.3 feet a year, and a single year's growth was measured of over 50 inches. The location is 230 miles north of the natural range.

From the time of the early enthusiasm in planting slash pine the author has consistently cautioned against planting farther north than about 100 miles from the natural range border, except on a purely experimental scale. This was based upon the well-known behavior of various other tree species when planted far northward of their natural ranges, namely, a rapid slowing up in growth after the first few years. The lack of production of viable seeds may be regarded as a probable result from planting slash far above its present home range. Susceptibility to serious damage by freezing and by sleet is always to be looked for in such northward moving of tree species. It is known that the wood of young slash characteristically possesses a relatively high density of summerwood, which may enable it to escape to a large degree stem injury by sleet; yet its shallow root system makes it susceptible to partial or complete uprooting by heavy sleet.

There is good evidence pointing to a natural advance or migration northward of slash pine. Its rapid rate of growth when planted above its natural range, apparently averaging just as much as its average elsewhere, is a good indication that such a movement is taking place. In 1917, while conducting the study of slash pine, I was informed by C. B. Harman of Georgia, a former lumberman along the middle Savannah River, of his having felled slash pine trees of very large sizes, ranging from 4 to 5 feet in diameter, along the very northern limit of the species, in Jenkins County in central eastern Georgia. The situation in regard to the northward migration of slash is very similar, according to the author's views, to that of the southern cypress. When planted, the latter grows well far north of its natural northern

limit, in eastern Maryland and Delaware, to as far as eastern Massachusetts and western New York. Time only will give the answer of how far northward the growing of slash pine on a commercial scale is possible and practical.

A factor which is bringing slash pine strongly into favor for planting north of its natural home is its freedom from attack by the Nantucket tip moth, which is abundant and badly attacks almost all plantations of shortleaf, loblolly, and pitch pines in the eastern United States. Incidentally, in planting slash outside of its native range a common mistake is to choose a low, cold, frosty site. Its occurrence in wet lands in the South is known to be in considerable measure due to the protection these lands afford from fire, since the tree is more susceptible to injury by fire than is longleaf, particularly in its younger stages. In planting slash north of its home range, one should choose warm south-facing slopes having good air drainage and good qualitv and depth of soil. Frost pockets should be avoided.

On the basis of results thus far obtained from experiments, it would seem reasonable to expect fair results from slash pine planted on the better grade of sites in the lower and southern portions of the coastal plains of North Carolina, over the lower two-thirds or more of South Carolina, Georgia, Alabama, and Mississippi, in most of Louisiana, and in southeastern Arkansas and extreme southeastern Texas.

Management

The change in popular thought and actual practice in the matter of management during the past 20 years is a big story, which can only be touched upon now. Twenty years ago it was customary to turpentine second-growth stands by deep and wide chipping, and often by boxing, for a standard period of 3 years, after which back-facing followed for another 3 years if the "crop" of trees had not dry-faced or been burned down by fires or badly broken by winds. Now, by contrast, the prevailing practice is shallow and narrow chipping by cupping for a 5-year period, with good protection of the faces, if not the ground cover itself, against fire, and then, usually after a resting period, back-cupping for 5 years. The total period of working usually covers from 10 to 12 years, but sometimes the plan of management makes it nearer 20 to 24 years. Following turpentining, many owners are utilizing their timber for poles, crossties, pulpwood, or fuelwood.

THE INFLUENCE OF WINDBREAKS IN PROTECTING CITRUS ORCHARDS[1]

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Windbreaks probably receive most intensive attention in the citrus region of California. With a bearing orchard worth as much as $5,000 per acre, considerable money can be spent for windbreaks to protect the citrus trees from the high winds. It is estimated that it pays to devote 10 per cent of the orchard area to windbreak trees and to spend $15 per orchard acre for windbreak maintenance. To get effective protection the windbreaks are planted 300 to 400 feet apart. The author also discusses wood lattice frames, which have come into some use recently for protecting new orchards and to give quick protection while the windbreak trees are getting established.

FOR many years wind has been recognized as a factor of major importance influencing crops and the comfort and well-being of residents of many sections of the country. Recent dust storms in the Great Plains country and widespread discussion of the proposed shelter-belt project through that country from North Dakota to Texas have aroused a good deal of interest in the general subject of windbreaks. Unfortunately some extravagant statements and claims as to the influence of tree planting over extensive areas have been given wide publicity and have resulted in much comment and not a little antagonism towards this project. Much experimental work must be carried on in that region, and undoubtedly ways will be found to conquer many of the difficulties presented. There can be no reasonable doubt of the great influence exerted by a good windbreak on the growing conditions and productivity of a strip of territory immediately in its lee; and the present paper summarizes the results of observations made in several of the citrus districts of California to determine how important such protection is.

For more than ten years the writer has been gathering data on windbreaks in California in cooperation with a number of interested individuals who have contributed much time and effort to the project. Chief among these should be mentioned Farm Advisors Harold Wahlberg of Orange County, Henry Wilder of San Bernardino County, Vincent Blanchard of Ventura County, and M. B. Rounds of Los Angeles County. Meteorologist Floyd Young of the United States Weather Bureau—a recognized authority on windbreaks as a result of his experimental work—has assisted materially in the set-up and maintenance of instruments and has made many helpful suggestions. The cooperative work of John Lundemo of Fontana, Guy Varnum of San Fernando, and H. A. Gardner of Villa Park in keeping field records of the anemometers has been particularly effective, and a number of managers of packing houses have contributed significant packing house records.

Importance of the Wind Problem

Nearly all parts of the citrus-growing area of California are subject to occasional damage by severe winds. A few

[1]Presented at Meteorological Section, American Association for Advancement of Science, Los Angeles, Calif., June, 1935.

[2]State Extension Forester, California.

districts, such as Redlands and Highlands, are almost immune; in others damage occurs only at intervals of 5 to 10 years; but in most of the important citrus districts wind damage is of quite frequent occurrence. Warren Schoonover, Extension Specialist in Citriculture of the University, estimates that loss of fruit during bad wind years amounts to complete destruction of 3 to 4 million boxes of fruit, with indeterminate damage from scarring to the fruit left on the trees and additional damage to the trees so that they bear less fruit on the windward side. Floyd Young believes that in some of the worst years an estimate of a million dollars to cover damage due to loss of fruit and tree injury would be very conservative.

Some scarring of fruit probably occurs with winds having a velocity of 15 to 20 miles per hour. Some fruit will be shaken off the trees by winds with a velocity of 25 to 30 miles, and stronger winds of 30 to 40 miles per hour put most of the fruit from unprotected orchards on the ground. Damage is intensified with increase in gustiness of the wind, with low humidity, and with increase in temperature. Under such conditions trees often lose a large part of their foliage and even some branches may be killed. Reed and Bartholomew[3] found that death of twigs and smaller limbs resulted mainly from effects produced by the scorched leaves which remain attached to them, rather than by the direct effect of the wind. Trees subjected to recurring damage of this kind become deformed and weakened, and are more susceptible to attack by diseases and insects—particularly red scale.

Protecting Trees from Wind Damage

For many years attention has been given to effective methods of protecting citrus orchards from damage by wind. Hundreds of miles of tree windbreaks planted and cared for in windy sections have been removed by new owners of orchards following a few years of subnormal winds, with disastrous results to the entire district. Packing house records for the Villa Park section of Orange County from 1919 to 1926 following such removal of windbreak protection were so striking an example of this fact as to result in a large increase in windbreak planting throughout the county. Four of the 8 years brought only moderate winds, and shipments averaged 565 carloads per year, but 1920, 1922, 1923, and 1925 were years of severe winds, during which annual shipments averaged only 318 cars of fruit. Thus during this 8-year period the loss principally due to insufficient wind protection amounted to a total of 912 cars. Based on actual returns, the four bad years showed 390,703 less boxes of fruit than the good years, with a resultant drop in proceeds amounting to $671,009 below those received during the years of little wind damage.

Failure to provide wind protection for orchards or the willingness of some owners to remove windbreaks already established is due to their reluctance to give the required area of ground the necessary fertilization, irrigation, and other care needed to keep the windbreak trees in vigorous condition. Many people have had an exaggerated idea of the seriousness of root competition and lacked knowledge of effective methods to control windbreak roots by deep sub-soil pruning. Experiments were therefore necessary to determine the effective zone of protection provided by well-kept windbreaks, the species of trees most suitable for windbreaks, the cultural operations needed to keep them in good condition, and the influences exerted by well located and ade-

[3]The effects of desiccating winds on citrus trees, Bull. 484, Univ. of Calif. Agric. Exp. Sta., January, 1930.

quately maintained belts of trees. In the last two years some attention has been given to the wooden lattice windbreaks which have been constructed in several localities.

Zone of Effective Windbreak Protection

In order to determine how far apart windbreak rows could be spaced to give adequate protection to citrus trees, anemometers were installed at a number of places at varying distances behind windbreaks, with check instruments placed in the open. The standard height of these installations was 12 feet from the ground, which is approximately the height of the average citrus tree crown. One of the first of such installations was made near King City, on lands of the California Orchards Company, during the summer of 1927. The instruments, set in an open bean field about 1,000 feet distant from any obstruction to wind movement, gave the following readings:

Month	Average daily maximum velocity per hour	Highest daily maximum velocity per hour
	Miles	Miles
June	22.3	27
July	19.3	22
August	19.6	25
September	22.1	26

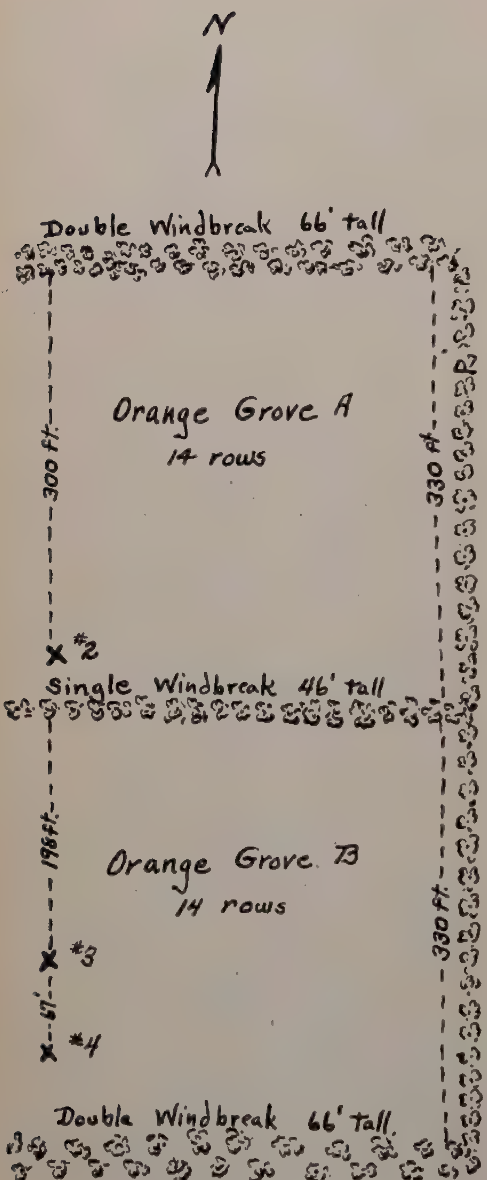
A second instrument was set for a time at the same height from the ground (12 feet) and 100 feet in the lee of a 35-foot blue gum (*Eucalyptus globulus*) windbreak. The average and maximum wind velocities here were reduced to 34 per cent of those in the open. This instrument was then moved to a distance of 200 feet from the same single windbreak row. Here the average and maximum wind velocities were 49 per cent of those in the open.

During that winter Mr. Young installed two anemometers in the Villa Park section of Orange County. One of these was in an orange grove unprotected by a windbreak; the other was 500 feet in the lee of a blue gum and Monterey cypress windbreak from 90 to 100 feet tall. Detailed figures for a windstorm of December 17th and 18th are given in Table 1. At the protected station the total wind movement was 72 per cent of that in the open, and at several periods the maximum velocity recorded was but 60 per cent of that at the unprotected station.

In a letter under date of December 25, 1927, Harold A. Rathbone, Meteorologist, in enclosing these figures to Harold Wahlberg says: "After a thorough survey of the Villa Park district I can hardly see how a sane man can be 'on the fence' relative to the merits or necessity of adequate windbreak protection. It seems to me that the only solution of the wind damage problem is either more windbreaks or pull the trees."

During this same storm 3 anemometers were running at Fontana. One was in an open field, one in an orange grove distant 305 feet from a double row of blue gum 66 feet high, and one in the next block of oranges to leeward from Station 2 and 192 feet from a single row of blue gums 46 feet high. (Fig. 1.) Thus Station 3 was 522 feet to leeward from the double windbreak protecting Station 2. Full figures for the 24-hour period of the storm are given in Table 2. The total wind movement at Station 2 was only 29 per cent of that in the open. That at Station 3 was 32 per cent of that in the open, showing that the cumulative effect of the second windbreak was not quite sufficient to compensate for its shorter height.

The vital importance of adequate height in windbreak trees was brought out in this same orchard during a similar severe storm in December, 1926, which caused very high loss of fruit in unprotected orchards. During this storm the double



Anemometers set at 12 feet above ground slightly above top of orange tree crowns. Check instrument in open field 301 feet east. Heavy winds blow from the north.

Fig. 1.—Anemometer installation at Fontana 1927-28.

TABLE 1[1]

COMPARATIVE FIGURES OBTAINED BY WEATHER BUREAU NEAR VILLA PARK IN WIND OF DECEMBER 17-18, 1927. WINDBREAK IS EUCALYPTUS AND CYPRESS 90 TO 100 FEET TALL. A—SHELLY HORTON STATION, IN OPEN. B—W. PERRY STATION, 500 FEET BEHIND WINDBREAK.

	A.M.			Noon	P.M.											Midnight	A.M.				
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
Total hourly movement, miles—A	23	26	29	33	25	25	26	27	24	21	20	24	22	24	25	19	20	14	14	15	10
—B	19	19	22	21	19	21	19	20	17	16	16	19	14	18	19	11	11	10	9	10	6
Maximum velocity, miles—A	28	33	33	33	28	32	32	34	30	27	26	28	25	25	32	24	24	20	19	18	14
—B	20	23	28	24	22	24	22	23	18	20	19	24	19	24	23	17	13	12	12	14	8
Relative humidity, per cent—A	26	25	26	25	26	24	24	24	25	25	24	24	22	17	22	23	23	24	24	24	25
—B	24	24	25	25	23	23	23	23	24	23	24	23	21	21	22	23					

[1]Reprinted from article by Floyd D. Young.

row of blue gums, then about 60 feet high, gave good protection to 13 rows of orange trees. Only row 14 showed slight dropping of fruit. However, the single row of blue gums, then about 40 feet high, furnished adequate protection to only 7 rows of trees (165 feet). The average drop of fruit per tree (based on weight picked up under 10 trees in each row) was found by Mr. Lundemo to be as follows:

Row number	Distance from windbreak (feet)	Drop of oranges in pounds per tree
8	176	7.8
9	198	12.1
10	220	11.1
11	242	16.5
12	264	24.7
13	286	19.2
14	308	8.5

It should be pointed out that the lower drop in row 14 might be due to a lowered total production on this row owing to competition from the adjacent windbreak row to the south, or it may be partly attributed to a slight banking effect to windward of this windbreak, making the air slightly less turbulent at this point. No anemometers were running in this grove at the time, so that it is not known what velocities the wind attained.

During February, 1927, Mr. Lundemo kept records from 5 anemometers at Fontana. The three instruments mentioned above were augmented by a fourth at a point 66 feet south of Station 3, and the fifth was situated at Fontana headquarters, in the center of several miles of windbreak plantings, at a point 35 feet above ground. Typical readings at these 5 stations are given in Table 3. The record at Station 5 is particularly interesting as a demonstration of the cumulative effect of good windbreak plantings over a considerable area even at the height of 35 feet above the ground, where the velocity proved to be 50 per cent or less of that in the open at 12 feet. Figure 1 shows the location of Stations 1 to 4 with relation to the double and single rows of windbreak trees.

During the same winter an attempt was made to determine what influence citrus trees themselves have on wind velocity without any other protection. A 15-year-old lemon grove at Fontana was used in this experiment, but the trees were in bad shape from lack of windbreak protec-

TABLE 2

WIND MOVEMENT AT FONTANA, CALIF., DURING STORM OF DECEMBER, 1927, AS RECORDED BY THREE ANEMOMETERS

Hour	—Miles of wind at stations— 1	2	3
	Dec. 17 Noon		
12-1	26	8	8
2	26	8	8
3	26	7	9
4	18	6	6
5	20	5	6
6	18	6	6
7	19	5	7
8	26	6	8
9	27	7	8
10	30	8	8
11	26	8	8
	Dec. 18		
12	29	8	9
1	37	11	11
2	37	10	11
3	42	13	13
4	46	13	15
5	40	12	13
6	33	11	12
7	33	10	11
8	31	10	11
9	32	10	10
10	36	13	14
11	47	14	15
12	46	14	15
Total wind movement:	761	223	244
Totals in per cent of Station 1:	100	29	32

Station 1: 12 feet from ground in an open field.

Station 2: 12 feet from ground in an orange grove 305 feet in the lee of a double row of blue gums 66 feet high.

Station 3: Same height in second block of oranges 192 feet in lee of a single row of blue gums 46 feet high and 522 feet from the above double windbreak.

tion and had practically no fruit on them. One anemometer was set up in the open 175 feet north of the grove and the other was placed at a point 260 feet south of the first row of lemon trees, each at 12 feet off the ground. The instruments were thus 435 feet apart. Comparative readings were as follows:

Station 1, in open	Station 2, in unprotected grove
Average movement of wind per hour	
15	9.1
22.7	28.8
16.5	13.6
21.0	19.3
12.4	10.1
8.1	6.4
20.6	17.5
20.6	17.0
24.5	18.0

TABLE 3

TYPICAL WIND MOVEMENT AT FONTANA, CALIFORNIA, AS RECORDED BY 5 ANEMOMETERS IN FEBRUARY, 1928

Hour	Miles of wind at stations 1	2	3	4	5
February 7 and 8					
12-1 P.M.	15	5	6	5	6
7-8 P.M.	17	4	5	5	11
4-5 A.M.	24	6	7	4	12
8-9 A.M.	21	5	6	7	11
Av. for 24 hrs.	16.5	4.5	5.1	5.3	9.0
February 9 and 10					
2-3 P.M.	22	5	5	7	13
3-4 P.M.	21	7	7	6	11
11-12 P.M.	15	3	3	5	7
9-10 A.M.	19	5	5	6	9
Av. for 24 hrs.	13.7	3.5	4.0	4.0	7.3
February 26 and 27					
12-1 P.M.	27	8	8	10	15
3-4 P.M.	24	7	8	8	19
9-10 P.M.	23	7	7	8	14
3-4 A.M.	19	5	6	6	10
10-11 A.M.	22	2	1	1	2
Av. for 24 hrs.	19	5.3	5.6	5.9	11.5
February 15 and 16					
Av. for 24 hrs.	14.4	4.2	4.3	4.7	6.4
December 18					
12-1 P.M.	47	15	16	—	21
2-3 P.M.	34	11	11		14

See Figure 1 for location of stations 1 to 4. Station 5 was on a tower 35 feet tall near the center of the Fontana protected orchard area.

Averaging the above readings, the velocity of wind in the unprotected grove is seen to be about 80 per cent of that in the open; but this advantage is more seeming than real, as the trees were a total loss as far as production was concerned.

From these and similar observations we have concluded that the zone of effective protection by a windbreak for citrus trees is from 5 to 7 times the height of the average trees in the windbreak. Therefore, with blue gum eucalyptus trees about 60 to 65 feet high, windbreaks should be spaced every 300 to 400 feet. In most orchards a distance of 330 feet seems to be the most convenient, as this is the distance across a 5-acre block and gives room for 14 rows of orchard trees between windbreak rows. If a distance of 15 feet on each side of the windbreak is assigned to the eucalyptus trees, and this is about the least area that they can thrive on, it means that slightly more than 9 per cent of the area of a citrus property will be permanently dedicated to windbreak trees.

How Much Does a Windbreak Cost?

A good general rule to follow is that a windbreak should have at least as good care as the orchard it is designed to protect. This includes irrigation, fertilization, cultivation, top pruning to obviate windfall during the first few years, and root pruning on alternate years to confine the roots within reasonable bounds. Using a liberal figure of $150 per acre per year given by Schoonover as a reasonable cost for maintenance of citrus groves, the 0.91 acres in two windbreak rows needed to protect the average 10 acres of orchard will cost $136.50 a year. This is a charge of approximately $15 a year on each of the 9.09 acres producing oranges or lemons. The cost will probably be somewhat less during the first 5 or 6 years. Is the protection worth it?

The Value of Windbreak Protection

Sufficient records have been kept during the past 8 years in several citrus districts to show that adequate windbreak protection is worth far more than it costs. This value is reflected in greater total production, higher quality and hence larger returns per acre, and in maintenance of better vigor in the orchard trees. One of the early records was kept by Mr. Lundemo for two areas of similar size in the Fontana district just adjacent to the block where the anemometer records were obtained. The two groves had the same fertilization, irrigation, and care, the only difference being that area A was fully protected and area B only partially protected from wind damage (Table 4).

Farm Advisor Wahlberg secured figures on two comparable orchards in the Yorba Linda district from Manager Adams of their Citrus Association. Here again the two groves were on similar soil and were given similar treatment with the exception that one was well protected from winds (Table 4A).

It was noted here that red scale was worse in the unprotected orchard because this pest thrives best in open-foliaged trees.

From a number of packing house records in Orange County for 1933, Wahlberg selected records for 26 orchards of comparable size, soil condition, and methods of treatment. Of these 13 had good windbreak protection and 13 had not (Table 4B).

This shows an increase in money yield in favor of the protected orchards of \$91.96 per acre. If from this is deducted the \$15 per acre estimated above as the cost of windbreak maintenance, it still gives a net advantage to the protected area of \$76.96 per acre. This equals a return of 6 per cent on a valuation of \$1,282 per acre, which is perhaps a fair way of estimating the value of a windbreak during a year of about average wind velocity.

The value of windbreaks is not confined to the protection they give citrus groves from hot, dry, interior winds. They may be quite as important in giving shelter from the less intense though cool and steady winds from off the ocean. During 1934 the writer and Farm Advisor Vincent Blanchard made fruit counts in two Eureka lemon groves in the coastal citrus district near Ventura. Results of these counts have caused a marked increase in interest in windbreaks in Ventura County. (Tables 4C, 4D.)

In the first case with the same cultural methods, age of trees, and soil conditions the trees well protected from wind are double the size of the unprotected trees and had a crop of more than five times as many lemons.

Under the conditions shown in Table 4D, with 80 trees per acre the yield from

Table 4

PACK OF ORANGES FROM TWO AREAS IN THE FONTANA SECTION

Grade	Protected area Pounds	Protected area Per cent	Partly protected area Pounds	Partly protected area Per cent
Sunkist	35,934	67.6	13,777	50.9
Redball	8,728	16.4	4,188	15.5
Standards	5,184	9.7	3,281	12.1
Culls	3,313	6.3	4,896	18.0
Windfalls			972	3.5
Per cent Sunkist and Redball		84.0		66.4
Total yield per acre	13,200		10,640	
Value of fruit per tree		\$6.33		\$ 3.39
Average value per pound		\$0.0384		\$ 0.0255
Value of fruit per acre		\$506.88		\$271.28

wind protected trees would be 286 boxes of fruit per acre, while that from the wind damaged trees would be only 43.6 boxes per acre with 90 trees per acre. It is, therefore, evident that even in this coastal belt we are very conservative in stating that 10 per cent of a citrus property can well be devoted to the growing of good windbreaks.

What Tree Species are Best for Windbreaks?

The ideal windbreak tree must grow vigorously and rapidly to maximum height, must be able to survive a variety of climatic conditions, and should maintain a good mantle of foliage down to the ground in its later years. Unfortunately there is no such tree, but the blue gum (*Eucalyptus globulus*) comes nearest to fulfilling these requirements in most of the citrus growing districts of California. It does not do well in Imperial Valley, and its place has been taken there by red gum (*E. rostrata*), desert gum (*E. rudis*), and desert athel (*Tamarix articulata*). The two eucalypts are more open foliaged and the athel, though it grows easily from cuttings and is resistant to alkali, is short in stature, breaks easily in heavy winds, and has a wide-spreading and very competitive root system.

Monterey cypress (*Cupressus macrocarpa*), which has been an excellent windbreak tree near the coast, can no longer be recommended because of its susceptibility to attack by the cypress canker and scale and bark beetles. Arizona cypress (*C. arizonica*) has done fairly well in some interior sections, but grows more slowly than eucalyptus and is somewhat susceptible to the same cypress disease.

Blue gum trees do have the habit of dropping their lower branches as they reach a height of 50 feet and above, and tests are now being made with the bushy variety (*E. globulus compacta*) as an in-

Table 4a

Comparative pack of fruit from two orchards, Yorba Linda District. 1933

Grade	Protected from wind	Unprotected
	Per cent	Per cent
No. 1	40.3	23.6
No. 2	24.9	31.0
No. 3	14.5	8.5
Culls	18.0	37.0
Production:	585 field boxes	188 field boxes
Value per field box	$1.10	$0.787

Table 4b

Returns from 26 orchards in Orange County in 1933

Grade	13 with windbreak protection	13 without protection
	Per cent	Per cent
Fancy	7.22	1.25
Sunkist	74.08	59.26
Redball	18.7	39.49
Average field boxes per acre	455	371
Average packed boxes per acre	268	202
Pack-out, per cent	59	54
Boxes per acre:		
Fancy grade	19.34	2.52
Sunkist grade	198.53	111.97
Redball grade	50.12	79.76
Returns per acre:		
Fancy grade @ $1.42	$ 27.46	$ 3.57
Sunkist grade @ $0.92	$182.64	$103.01
Redball grade @ $0.39	$ 19.54	$ 31.10
Total returns per acre	$229.64	$137.68

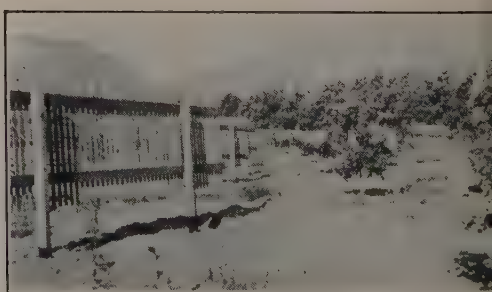


Fig. 2.—Small lattice windbreaks used at the Varnum Ranch to give temporary protection to young citrus trees while blue-gum windbreaks are developing sufficient height to give permanent protection.

TABLE 4C

1. FRUIT COUNTS IN A 4-YEAR-OLD EUREKA LEMON GROVE

Wind-protected trees in Rows 2 & 3 from a Monterey cypress windbreak		Wind-injured trees Rows 7 & 8		Wind-injured trees Rows 11 & 12	
Tree	No. of fruits	Tree	No. of fruits	Tree	No. of fruits
1	544	1	65	1	38
2	224	2	79	2	36
3	386	3	13	3	88
4	170	4	81	4	44
5	120	5	37	5	45
				6	90
Totals:	1,444		275		341
Average per tree:	288		55		57

terplant. Where space is available, the opening of the lower crown may be overcome by planting two rows of trees and cutting out alternate trees after about ten years to induce a heavy growth of sprouts under the crowns of the bigger trees. This management practice not only insures a good mantle of foliage to the ground, but the cut trees yield a fairly continuous supply of firewood for the ranch.

WOODEN LATTICE WINDBREAKS

Recently a number of lattice windbreaks have been constructed in order to give immediate protection to groves and thus save the 5 or 6 years needed to get equivalent height with trees. Proponents of these lattices point out that they can be set up so as to allow passage of cultivating tools under them, and that they do not have roots to compete with the orchard trees. They have usually been constructed of 3/8- x 3-inch vertical laths nailed to a framework of 2 x 10 and 2 x 12 timbers set on concrete footings and braced with wires. The cost has varied from 75 cents a lineal foot for a lattice 20 feet high to as much as $2 a foot for more rigid and permanent construction. Perhaps the best example of such a windbreak was built on the T. P. Breslin ranch, near Hewes Park, Orange County. It is 32 feet high, 2,600 feet in length, and cost $1.10 a lineal foot. To secure adequate protection comparable to that furnished by eucalyptus will require the building of such a structure at least every 220 feet, or 1,980 lineal feet of lattice to every 10-acre block. This calls for an investment of over $200 per acre, with an annual depreciation charge at least as great as the cost of maintaining a windbreak in good condition. On this basis, the cost of maintaining such lattice windbreaks will be considerably greater than for rows of trees. Another big objection to such structures is their unsightliness as compared to trees.[4]

Mr. Guy Varnum made good use of temporary lath structures 4 x 8 feet in size, set on 4 x 4 posts a distance of 6

TABLE 4D

2. FRUIT COUNTS IN A 9-YEAR-OLD EUREKA LEMON GROVE NEAR OXNARD

Protected trees		Unprotected trees	
Tree	Fruits	Tree	Fruits
1	1,017	1	90
2	500	2	120
3	761	3	77
4	590	4	97
Total:	2,868	Total:	384
Average per tree:	717	Average per tree:	97

[4]*Author's Note.*—In the severe storm of October, 1935, several lattice windbreaks were badly damaged, while most tree rows were uninjured.

feet to windward of young grapefruit trees in the San Fernando district. These cost about $1 each, and anemometer records show that they decreased wind velocity about one-third at each tree crown. However, Mr. Varnum expects to use these only until the blue gum windbreaks he had planted have reached sufficient height to permanently protect the orchard.

In closing it is important to remember that citrus trees which are kept in vigorous condition through proper management and protection from attacks by diseases and insects are much less susceptible to damage by wind than those which are weakened in any way.

A Bamboo Pole for Measuring Heights in Dense Young Stands

CONSIDERABLE difficulty is frequently experienced in measuring heights and crown lengths in dense young even-aged stands. The use of hypsometers is almost prohibitively time-consuming because of the density of the foliage and uniformity of the heights encountered. In attempting to overcome these difficulties, measuring poles have often been used, but have generally proved unsatisfactory, due to excessive limberness or heaviness. A measuring pole that seems to preclude these limitations is described below.

The Lake City Branch of the Southern Forest Experiment Station has a number of thinning and fire-study plots in dense young even-aged slash pine, the true heights of which were easily measured by a simple and inexpensively constructed pole made by splicing three ordinary bamboo fishing poles. The poles were securely pieced together with baling wire to make a total length of 35 to 40 feet, as desired. The pole was then graduated in feet with 2-inch-wide white adhesive tape, the 5-foot intervals being painted red for identification. The tape is easily applied, and performs the dual purposes of marking and giving added binding. Half-inch tape was used to mark the pole in ½-foot intervals.

This pole is light in weight, provides little wind resistance, and is easily carried in an erect position from tree to tree. In slash pine no difficulty was experienced in working the pole through the branches to a position against the bole of the tree. With the pole so placed, trees can readily be measured to the nearest ¼ foot. Trees 6 to 8 feet taller than the pole can be measured by shoving the pole upward a known number of feet. Trees as tall as 43 feet were readily measured.

The speed with which this pole can be used is demonstrated by records showing that one man, with the assistance of a C. C. C. boy, measured and recorded the total tree heights and crown lengths of 400 trees in a 6-hour day.

Fishing poles, 1 inch in diameter at the base and 18 feet long, are ordinarily obtained at about 10 cents each. The total cost of the tape will run about 60 cents. The cost of the assembled pole is, therefore, less than $1. This makes it cheap enough to warrant discarding after a season's measurement in a locality, and thus avoids the transportation difficulties arising from such an awkward length—J. G. Osborne, *Southern Forest Experiment Station.*

WHY STUDY THE FAUNA OF THE LITTER?

By ARTHUR PAUL JACOT

Appalachian Forest Experiment Station

FOREST litter comprises fallen leaves, wood, fruit and flower parts, and the faeces of caterpillars, leaf-eating beetles, and of all the animal life of the forest. All these organic remains contain organic compounds which the tree roots may use as food, provided that two processes take place: reduction (to available form), and transportation (to the rootlets).

Reduction

Every square foot of normal woodland litter harbors from 120 to 150 different kinds of minute nonmicroscopic animals, totaling thousands of individuals. This does not include the larger insects or higher animals, nor the myriads of threadworms, litter earthworms, or truly microscopic animals. It is inconceivable that so many different kinds of animals (even only 70 different kinds), absolutely dependent on food for maintenance and reproduction, could be living in a carpet two inches deep without having some of them dependent upon the decaying plant parts for food. Of course the presence of mosses and lichens add other species, but these are not included in the samples on which the above figures are based.

Some of these animals eat the myriads of molds living on the leaf mould. Others eat out the fruiting bodies of these fungi. Still others feed on the faeces which fall from the overhanging vegetation, while others feed upon the bodies of the dead or dying. Finally, some are as predaceous as wolves and weasels. With all this specialization, there is ample room for some species, not yet accounted for, to feed on the decayed plant parts and thus hasten their reduction to simpler organic compounds.

Thus it may be stated with certainty that some of the litter animals are hastening the reduction of plant remains to smaller particles and to simpler compounds. In fact the entire layer of woodland litter is an unorganized factory for the reduction of the litter. This process is indirect because, although the plant remains must first be predigested by the molds before the animals will feed upon them, some of the animals eat these predigesting fungi, thus partly inhibiting their development or spread.

Reduction consists of the chewing up and grinding up of the dead leaves and their redeposition in the form of manure (minute faeces). It also consists of chemical reduction of the leaf tissues through the action of molds and bacteria. Even the faeces have to be further acted upon by molds and bacteria. The chief function of the animals therefore is the reduction of large surfaces to minute particles. This reduction gives a greater increase of surface, so that the bacteria and molds can work much more rapidly and efficiently. The animals are thus important in *speeding up* the process. But we have almost no positive evidence what animals do this reducing, though all the minute nonpredaceous litter animals are regarded as thus occupied. This is highly erroneous.

In undisturbed or virgin moist woodland of the warm temperate zone the process of reduction takes place in what

the forester may regard as an optimum or favorable condition.[1] In some areas, notably northern softwoods, the litter is reduced very slowly, almost more slowly than it accumulates. Is this due to absence of the right kind of molds or bacteria, or to the absence of some of the litter-reducing animals? Only a careful analysis of the litter fauna and the molds of optimum-reducing litters, compared with a similar analysis of poorly reducing litters, will answer this question of reduction. If, for instance, the (let us say) five species of rotten-leaf eaters of western North Carolina woodlands are absent from the woods of northern Maine, one may be quite certain that this absence is one of the causes for poor litter reduction. The next question will be, can these five North Carolina dead-leaf eaters be acclimatized in Maine woodlands or in old-field woodlands where reduction is too slow?

Transportation

Transportation of the ground-up and reduced leaves and the chemicals derived from them is usually regarded as carried on by water. But it is difficult for water to enter hard, compacted soil. If the soil is too compact, too dense, there is more run-off than percolation, and the organic compounds which should go into the soil go into the rivers. How does soil become loose and friable, as is characteristic of mull? Why isn't all soil mull? Can we make all soil mull?

Many of the hundred-odd species of minute animals of the litter enter the soil to lay their eggs or to shelter from drought. Some of the litter animals eat out the dead roots and rootlets of the trees and other plants, thus opening up the soil to water percolation. When the forest floor is occupied by a cover of herbaceous plants, especially annuals, there is an extensive annual crop of dead rootlets for the soil animals to eat out. Thus soils with a story or layer of annuals become light and porous through this continual channeling action of the microarthropods. Mull soils are characterized by a covering of herbaceous plants.

Where the woodland has developed on abandoned fields, much of this soil-channeling and dead-root-eating animal life has been eliminated by agricultural practice. It is therefore advisable to introduce it in order to rapidly establish good soil tilth and good percolation. But which of the many soil-inhabiting species should be introduced?

Not only do these dead-root eaters hollow out the rootlets, but they leave in the channel a thin thread of their faeces, which acts as fertilizer. When rainwater falls upon the surface of the soil not only does it find ready-made runnels into the soil, branching out in many directions, but also it takes the faeces along to lower levels, leaving them in closer proximity to growing rootlets which develop in the direction of these water runnels and water reservoirs.

Many of the field and meadow insects enter the woodlands during the late fall to hibernate in the litter or soil. In the Carolinian life zone these insects keep migrating, throughout the winter, between the soil and the litter. This also aids in maintaining soil channeling, but its cumulative effect is not as great as that of the far more numerous microarthropods which not only channel the soil but eat out the maze of dead roots. These minute animals make up in numbers what they lack in size.

Thus mull soil may be extended over any terrain which can be induced to support a herbaceous, preferably an annual cover. We have hundreds of native plants

[1]By favorable reduction is here meant complete reduction of a leaf fall within two years barring such local effects as wind accumulations.

to choose from. But we cannot grow acres of annuals and herds of herbivorous game animals on the same plots. Finally, the herbaceous cover loses its high value if the microarthropods are not there to eat out the dead roots.

Orientation

In the latest studies on the litter fauna (Bornebusch[2], Ulrich[3], Thamdrup[4]), no discrimination has been made between the various types of feeders. These workers have made calculations on total amount of faeces, total activity (oxygen consumption), food consumption, etc., on the assumption that all these forms were reducing the dead leaves, and possibly the dead wood. Thus their figures are very much higher than they should be.

Before such studies are of value it will be necessary to separate out of the great assortment of species those which are actually engaged in reducing the litter. Thus the primary problem is to determine the food habits of the so-called saprophytic species. This group alone includes feeders on fungi, algae, lichens, faeces, and carrion. As far as my observations go, only a very few saprophytic mites will feed on dead leaves under forced conditions. There is no positive evidence that any of them do so in a state of nature.

Therefore the entire study of litter reduction will be held up until the feeding habits of the abundant species of saprophytic microarthropods are determined, preferably by examination of stomach contents in microtome sections.

[2]Bornebusch, C. H. The fauna of forest soil. Det forstlige Forsogsvaesen i Danmark 11: 1-254. 28 pls., 7 txt. figs. 1930.

[3]Ulrich, Anton Th. Die Makrofauna der Waldstreu. Mitteil. aus Forstwirtsch. u Forstwiss. 4: 283-323. 6 figs. 1933.

[4]Thamdrup, Harald M. Faunistische und ökologische Studien über dänische Oribatiden. Zool. Jahrb., Abt. Syst. Okol. u. Geogr. Tiere 62: 289-330. 9 figs. 1932.

FOREST IMPROVEMENT WORK IN NEW HAMPSHIRE

By GEORGE PARSONS

Fox Research Fellow 1934-35

The principle of using unemployed labor for woods work is one which has long been accepted abroad, but had not been widely applied in this country until the present unemployment relief program was inaugurated. Stand improvement is well suited for relief work, since it can be done throughout the year and requires a minimum of equipment, allowing most of the money to be spent for wages. This article summarizes the results of a study of stand improvement work accomplished by various relief agencies in New Hampshire, with the main emphasis on costs.

IN the fall of 1934 the writer made a brief survey of stand improvement work being done by the various relief agencies in New Hampshire. The main purpose of the study was to gather cost data, and, secondly, to judge in a general way how effectively the work was accomplished. This study was made possible through the Fox Research Fellowship fund.

Data were obtained where available on acreage covered, man-hours per acre, and stand tallies (before and after cutting) from state and federal agencies in charge of the work. Specific information on other aspects of the work was obtained from C.C.C. camp suuerintendents and technical foremen, Forest Service rangers and inspectors, and through members of the state and federal experiment stations, as well as by looking over a small number of the operations in the field. Four state and five federal C.C.C. camps were visited, and at each camp one or more areas which had been worked by stand improvement crews were inspected. Four areas which had been covered by C.W.A. and S.R.A. (State Relief Administration) stand improvement crews were also inspected.

In relief work the main objective is to put men to work in a hurry, and the amount and quality of the work accomplished at the start are of secondary importance. Fuel-wood obtained as a by-product can be used advantageously by families on relief. In some instances stand improvement work was a stop-gap measure to keep men employed when there was too much snow for other projects. Labor as a whole was unskilled and had to be supervised closely. The question of supervision was a problem; even on the White Mountain National Forest foremen had to undergo a period of training before they could be trusted to carry out the work intelligently.

In the federal C.C.C. camps in northern New Hampshire the crews ranged in number from 15 to 20 men, with 3 to 4 men under a straw boss, or so-called "squad leader"; the entire crew in charge of a foreman, who was generally a technically trained forester. The plan was to instill in the squad leaders a knowledge of the technique of operations and to let them boss the groups under them. The foremen checked the completed work. This plan was probably a good one under the circumstances, since it was impossible for one foreman to look after 15 to 20 men satisfactorily. Trees to come out were not marked ahead of the crews; the squad leaders were supposed to know which trees should be cut or girdled. Type

TABLE 1

SUMMARY OF AREAS COVERED IN NEW HAMPSHIRE BY STAND IMPROVEMENT (TO JUNE 30, 1934)

	Acre
Federal C.C.C. camps	28,10
N.I.R.A. crews	7,40
State C.C.C. camps	2,93
C.W.A. and S.R.A. crews	68

maps made previous to starting the work showed in a general way the areas needing treatment.

In covering these areas the crews went across the country in strips, much as a felling crew in a logging job would go. Operations were confined to areas of merchantable timber, taking into account both stand per acre and accessibility for future logging. Stands having 2,000 board feet or more per acre were considered merchantable.

Most of the operations visited were a combination of weeding and release girdling. The main part of the work consisted of the elimination of wolf trees which were suppressing desirable species. Trees under 5 inches d.b.h. were cut, and those over that size were girdled. No tree was girdled if it would make a sound 16-foot log. No effort was made to market any of the material cut, but in most cases the amount cut per acre was so light that it would not have paid to take it out.

In C.W.A., S.R.A., and state C.C.C. work the squad leader plan was not followed, but in some cases the trees to come out were marked ahead of the crews by an experienced man, which simplified considerably the supervision of the crews by the foreman. Much of the stand improvement work done by these crews consisted of the weeding of white pine and the thinning of second-growth hardwood stands.

Cost of Stand Improvement

Federal C.C.C. camps and N.I.R.A. crews on the White Mountain National Forest.—For the purpose of cost computation C.C.C. labor was estimated by the Forest Service at $2 for a day of 8 hours, man-hour figures having been converted from the 6 hours actually worked. C.C.C. overhead ran very close to $2 per day, and was included in the figures shown in Table 2. The large variation between the man-day (and cost) figures per acre in various camps can be explained partially by the fact that on some areas the work was entirely girdling, while on others considerable weeding was being done as well, which was more time-consuming than the former. The areas worked by the Wild River and Cold River camps were in Maine.

The Forest Service furnished 1 per cent tallies of the treated areas, which for 5,370 acres in the Gale River section are shown in Table 3.

N.I.R.A. crews were made up of local men in need of work; pay was at the rate of 50 cents an hour for an eight-hour day; the foreman in charge was in most cases a forester furnished by the Forest Service. The N.I.R.A. cost figures furnished did not include supervision ex-

Table 2

SUMMARY COSTS OF STAND IMPROVEMENT WORK ON THE WHITE MOUNTAIN NATIONAL FOREST (TO JUNE 30, 1934)

Camp	Area (acres)	Man-days per acre	Cost per acre
Kilkenny	1,390	3.16	$12.61
Warren	1,836	1.767	7.05
Saco	7,721	0.932	3.72
Cold River	2,873	0.918	3.66
Wildwood	2,977	0.85	3.39
Campton	1,300	0.846	3.38
Gale River	5,370	0.755	3.01
Tripoli	1,254	0.589	2.35
Wild River	3,381	0.535	2.14
Total	28,102	0.985	$3.93 (average for entire area)
N.I.R.A.	7,400	——	$4.02
	35,502		

Table 3

CUT AND LEAVE TALLY

(Based on 1 per cent estimate of 5,075 acres in northern New Hampshire covered by stand improvement crews)

D.b.h. class Inches	Number of trees per acre: Cut and girdled	Left
0-4	39.1	161.1
6-10	15.7	55.6
12-16	5.5	14.2
17 +	4.9	3.9

pense. For an area of 903 acres for which detailed cost figures were available, the total cost including supervision was $5.60 per acre.

State C.C.C. camps on state land.—Work sheets showed a total of 2,931 acres covered in stand improvement work up to September 30, 1934. It was found on visiting some of these camps that very little of the work could be classed as stand improvement, since it consisted mainly of roadside improvement and park clean-up. (See Table 4.) At some of the camps weeding and thinning were being carried on to a limited extent, but on all but a few of these areas the records of man-hours and acreage were too fragmentary to be of much value.

C.W.A. and S.R.A. crews on state land.—On some of the areas the cutting of cordwood was the primary objective; stand improvement was secondary. Wood was figured for cost computation at the rate of $2 per cord; actually it was donated to the towns for relief purposes. Labor was paid at the rate of 50 cents and later at 40 cents, per hour. Costs of supervision were not available for most of the areas. It is interesting to note (Table 5) how the costs per acre as a whole decreased as the size of the tract increased.

Conclusions

It was hard in most cases to find so very much fault with the work, considering the difficulties under which it was done. Some areas were being treated though it is very doubtful if any good was accomplished; other areas will benefit considerably from the work. As a whole

Table 4

REPRESENTATIVE COSTS OF STAND IMPROVEMENT WORK BY STATE C.C.C. CAMPS

Area (acres)	Type of cutting	Cost per acre	Wood removed per acre (cords)	Net cost per acre
4	Weeding white pine	$97.50	4.	$89.50
4.5	Roadside improvement	87.50	7.8	71.90
50	General improvement	51.00	2.	47.00
45	General improvement	35.35	4.5	26.35
71.5	Release	7.23	—	7.23

Table 5

SAMPLE COSTS OF STAND IMPROVEMENT WORK BY C.W.A. AND S.R.A. RELIEF CREWS

Area (acres)	Type of cutting	Wood removed per acre (cords)	Man-hours per acre	Net cost per acre
	C.W.A.			
20	Weeding	2.5	122.4	$56.20
4	General improvement	6.25	127.5	51.25
20	Weeding	12.05	140.2	46.00
19.2	Weeding	—	78.5	39.25
47	Weeding	4.02	90.6	37.25
90	Weeding	0.77	33.7	15.30
35	Weeding	2.28	23.4	7.15
90	Weeding	—	6.20	3.10
	S.R.A.			
4	Weeding	3.75	142.6	$63.80
10	Thinning	3.7	88.25	36.72
23	General improvement	2.56	40.5	15.15
35	General improvement	6.0	51.9	13.95
14	Thinning	1.28	29.20	12.05
17	Weeding	—	15.5	7.75
92	Weeding	1.09	14.3	4.95
16	Weeding	—	9.64	4.82
172	Weeding	—	3.64	1.82

the stand improvement was the best on the areas worked by the federal C.C.C. crews, and the cost on these areas could be more nearly justified as other than an unemployment relief project.

The value of cost figures on work done by relief labor may be questioned. It is natural that the cost will run higher than work done in normal times by experienced labor, but it was felt that, since cost figures on stand improvement work are so limited, the collection of data on the work done on a large scale would be of value. It was hoped that cost figures could be obtained for different kinds and intensities of cuttings and in different timber types, but records were not complete enough to enable this to be done.

If stand improvement work is to be continued as a relief measure or as a regular expenditure, it is suggested that the following points be considered:

1. Silvicultural studies of the major forest types should be made to determine what kind and intensity of cutting would be of most benefit to the stand consistent with low cost per acre.

2. Studies should be made to find the best markets for material removed in stand improvement operations, with the ultimate aim of making the work self-supporting.

3. Planning and execution of the work should be done by trained men familiar with local conditions. Type maps should be made in advance, and the trees to come out, unless very small, should be marked ahead of the crews. Areas needing treatment should be done as a unit rather than stripping an area regardless of the type and need of treatment.

Stand tallies of a small percentage of the areas covered are valuable to show what has been taken and what remains.

Areas treated should be measured and not estimated, and man-hour figures for each area and, if possible, for each type should be kept for cost record purposes.

AN ALINEMENT CHART FOR ESTIMATING NUMBER OF NEEDLES ON WESTERN WHITE PINE REPRODUCTION[1]

By T. S. BUCHANAN[2]

Since its introduction into the West at Point Grey, British Columbia, in 1910 white pine blister rust has spread rapidly, and is now a major factor in the management of western white pine stands in northern Idaho. To study the relations between this species and ribes, the alternate host for white pine blister rust, some measure of the target afforded by the pines is imperative. The number of needles on a tree is the logical basis for indicating the target presented, since it is through the needles that pine infection takes place. The purpose of this paper is to make available a chart from which the number of needles presented by large numbers of white pine trees can be determined from measurements of crown length and crown width of the respective trees, correction factors being applied for abnormal trees.

In many field studies of white pine blister rust (*Cronartium ribicola* Fisch.) conducted by the Division of Forest Pathology on western white pine (*Pinus monticola* Douglas) it was found desirable to have some measure of the target which was presented by the pines to the sporidia liberated by associated ribes.[3] Crown length and width measurements were found to be fairly satisfactory units of measurement for comparing pairs of trees; but when endeavoring to arrive at a figure for total target exposed by a group of trees, it was found quite impossible to secure any significant values by combination of these measurements. The number of needles on a tree, since it is through them that blister rust enters,[4, 5, 6] gives the most accurate possible measurement of target presented. This unit of measure is not only the most satisfactory for individual trees but lends itself most admirably for determining the total target exposed by a group of trees.

Opportunity for making a study of the number of needles on western white pine reproduction was presented in conjunction with other studies conducted in British Columbia, Canada, in 1928. Further data were taken in 1930 which greatly increased the basis previously secured. Measurements of crown lengths, crown widths, and number of needles thus becoming available, the possibility of correlating them in the form of an alinement chart was recognized.

The writer has been unable to find any reference to a similar plan of needle determination. This particular study is based entirely upon western white pine needle numbers, but no obstacles are apparent to prevent similar studies being carried out on other species whenever such information may become sufficiently desirable to justify the costs involved.

To indicate possible restrictions in the use of the final chart, the description of the areas from which the original data

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[1]The writer is indebted to H. G. Lachmund, under whose direction the studies reported herein were undertaken, and to J. L. Mielke, J. R. Hansbrough, C. N. Partington, T. W. Childs, J. W. Kimmey, A. A. McCready, and W. F. Cummins for assistance in the collection and compilation of data used in this paper.

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[3]The common noun "ribes" is used to include both *Ribes* and *Grossularia*, the alternate hosts of white pine blister rust.

[4]Clinton, G. P. and F. A. McCormick. Infection experiments of *Pinus strobus* with *Cronartium ribicola*. Conn. Agr. Expt. Sta. Bull. 214: 428-459. 1919.

[5]Snell, W. H. and A. R. Gravatt. Inoculation of *Pinus strobus* trees with sporidia of *Cronartium ribicola*. Phytopath. 12: 584-590. 1925.

[6]York, H. H. and W. H. Snell, Experiments in the infection of *Pinus strobus* with *Cronartium ribicola*. Phytopath. 12: 148-150. 1922.

were secured and the field and statistical methods used in constructing the chart will be discussed in brief detail.

Description of Study Areas

Crown lengths and crown widths were measured and the number of needles was estimated, following the 1928 seasonal development, on 2,574 western white pine trees on three areas at Hunter's Siding, British Columbia, near the head of Slocan Lake. Similar data were also taken on two analogous areas near Nelson, British Columbia, the trees at either locality ranging from 0.1 to 30.0 feet in crown length. In 1930 the trees on these five areas were again measured, and two additional areas were included at Hunter's Siding. In 1930 a total of 4,235 trees was measured, giving 6,809 measurements for the two years.

These study areas were located very close to the geographical center of the white pine range in the northern Idaho-southern British Columbia region, the areas at Hunter's Siding being slightly farther north than those near Nelson. All plots were on old, well-drained burns; the slopes ranged from level to moderate, and the exposure was southerly on all but the level plots. The Nelson plots were roughly 3,000 feet in elevation; those at Hunter's Siding varied but little from 2,000 feet. All plots were circular in form, with a radius of 150 feet. The white pines were of the size and distribution typical of that successional stage where the largest pines were just beginning to overtop the birches, aspens, willows, and alders which were the primary invaders following fire. The white pines, then, were neither crowded and suppressed nor of the bushy form typical of open-grown reproduction.

Field Methods Used

Crown lengths and widths were measured directly with a 7-foot measuring pole. Crown width was taken at the widest portion of the living crown, this point being almost invariably coincident with the base of the living crown. In many cases, particularly in the smaller size classes and because of the absence of competition, the crown extended entirely to the ground; and in no case was the lowest living branch more than a very few feet above the ground.

Difficulty was encountered in finding a satisfactory system for taking needle counts. To provide knowledge upon which to base future estimates, actual counts were imperative at the beginning of the study. The individual needle bundles were counted and then multiplied by five to arrive at the total for the tree. As the study progressed the practice of selecting an average-sized branch, counting the needles on it, and then multiplying by the number of branches on the tree was adopted. Before the completion of the study the method was further modified by making a careful estimate rather than an actual count of the selected average-sized branch. Taking actual counts occasionally throughout the study provided an excellent check, and showed that but slight error was being made in the estimates. Needle counts following the 1930 seasonal development were made without first referring to the counts made on the same tree following the 1928 seasonal development, thus eliminating cumulative errors. Counts made in 1930, on trees also taken in 1928, ranged consistently higher, and thus provided an additional check on the accuracy of the data. In both years, needle counts were made in mid- to late summer, after the current season's needles were formed but before severe casting of older needles in the fall. Thus the trees were in a stage of maximum needle retention, and this fact must be borne in mind when using the final chart.

Presentation of Data

A total of 2,923 tree measurements was available for use in the final analysis after the 6,809 original measurements[7] had been carefully gone over and those discarded which showed any abnormalities, such as mechanical injury, aphid infestation, or other deformities caused by competing vegetation. These 2,923 measurements were then segregated into crown-length classes and were further subdivided into crown-width classes within those crown-length classes. Table 1 shows the crown-length and crown-width classes used and the basis of tree measurements available in each of the 68 groups. The arithmetical average for crown length, crown width, and number of needles was then determined for each group.

These data were then transposed to alinement chart form from the series of harmonized curves employed in the initial stages.[8] Two sets of harmonized curves were used to permit more accurate interpolation than could have been done with one series including such a wide range of values. The final chart (Fig. 1) was derived in the usual manner, all axes being graduated logarithmically, the method employed being essentially the same as outlined in the citation referred to in footnote 8, and sections 130, 145, and 146 in particular. The formula

$$1.36LW^{1.16} = \text{thousands of needles,}$$

in which L equals vertical crown length in feet and W equals basal crown width in feet, is the mathematical expression of the chart values. In this connection it

Table 1

CROWN-LENGTH AND CROWN-WIDTH CLASSES USED, AND BASIS OF TREE MEASUREMENTS AVAILABLE IN EACH CLASS

<table>
<tr><th rowspan="2">CROWN WIDTH CLASS</th><th colspan="19">CROWN LENGTH CLASS</th></tr>
<tr><th>0.1'-1.0'</th><th>1.1-2.0</th><th>2.1-3.0</th><th>3.1-4.0</th><th>4.1-5.0</th><th>5.1-6.0</th><th>6.1-7.0</th><th>7.1-8.0</th><th>8.1-9.0</th><th>9.1-10.0</th><th>10.1-12.0</th><th>12.1-14.0</th><th>14.1-16.0</th><th>16.1-18.0</th><th>18.1-20.0</th><th>20.1-22.0</th><th>22.1-26.0</th><th>26.1-30.0</th><th></th></tr>
<tr><td>0.1'-1.0'</td><td>132</td><td>67</td><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1.1-2.0</td><td>40</td><td>145</td><td>122</td><td>22</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.1-3.0</td><td></td><td>23</td><td>130</td><td>159</td><td>64</td><td>14</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.1-4.0</td><td></td><td></td><td></td><td>61</td><td>120</td><td>82</td><td>41</td><td>18</td><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.1-5.0</td><td></td><td></td><td></td><td>4</td><td>24</td><td>79</td><td>68</td><td>65</td><td>30</td><td>14</td><td rowspan="2">55</td><td rowspan="2">18</td><td rowspan="2">7</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.1-6.0</td><td></td><td></td><td></td><td></td><td></td><td>9</td><td>38</td><td>53</td><td>70</td><td>61</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6.1-7.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td>3</td><td>14</td><td>20</td><td>59</td><td rowspan="2">80</td><td rowspan="2">80</td><td rowspan="2">65</td><td rowspan="2">32</td><td rowspan="2">12</td><td rowspan="2">2</td><td></td><td></td><td></td></tr>
<tr><td>7.1-8.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>8</td><td></td><td></td><td></td></tr>
<tr><td>8.1-10.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>31</td><td>62</td><td>79</td><td>80</td><td>44</td><td>36</td><td>17</td><td>6</td><td></td></tr>
<tr><td>10.1-12.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>7</td><td>15</td><td>34</td><td>50</td><td>41</td><td>55</td><td>23</td><td></td></tr>
<tr><td>12.1-14.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>13</td><td>18</td><td>31</td><td>27</td><td></td></tr>
<tr><td>14.1-16.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>5</td><td>14</td><td>10</td><td></td></tr>
<tr><td>16.1-18.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>2</td><td>5</td><td>TOTAL</td></tr>
<tr><td>TOTAL</td><td>172</td><td>235</td><td>256</td><td>246</td><td>208</td><td>184</td><td>150</td><td>150</td><td>124</td><td>142</td><td>166</td><td>167</td><td>166</td><td>146</td><td>119</td><td>102</td><td>119</td><td>71</td><td>2923</td></tr>
</table>

[7]Data showing the extent of duplication resulting from measuring trees in 1930 which had also been measured in 1928 are not available. Since two years elapsed between measurements, during which time the reproduction underwent considerable change, it was felt permissible to treat such duplications essentially as two trees.

[8]Bruce, D. and F. X. Schumacher. Forest mensuration. McGraw Hill Book Co. pp. 360. 1935.

was interesting to find that the formula

$\pi\ r\ s =$ thousands of needles

gave values roughly duplicating those read from the chart. This will be recognized as the formula for determining the surface area of a cone where r equals basal radius of the cone in feet and s equals the slant height in feet.

The accuracy of this chart was then compared with the basic data from which it was derived. Using the figures for the 68 group averages and comparing them with similar values read from the chart, an aggregate difference of only 1.43 per cent low was found to be present. This shows that no errors of any significance occurred in transposing the basic data to alinement chart form, and that a very satisfactory degree of accuracy can be obtained when a large number of trees are measured and their numbers of needles determined by use of the chart. Taking a 5 per cent mechanically selected sample of the basic data and comparing these values to corresponding values as read from the chart, the average deviation was determined to be 39.5 per cent. This figure plainly indicates that the number of needles on the *individual* tree cannot be accurately determined by the chart method. The determination of this percentage for each of four sections of the chart, as well as for the entire group, showed by their close agreement that the use of a 5 per cent sample was satisfactory for the determination of this value, and that the chart is consistent throughout.

Application

The chart having been prepared and its accuracy determined, it is now ready to be applied. To use this chart it is only necessary to connect the points for crown width and crown length, as measured in the field, with a straight-edge; the point of intersection with the central axis indicates the number of needles on a tree having such measurements. It will be noted, however, that the number on the central axis must be multiplied by 1,000 to give the true figure indicative of the number of needles on the tree.

This chart is being used by the Division of Forest Pathology with satisfactory results. In the spring of 1933 it was used for determining the number of needles on 830 trees on two study areas near Nelson, British Columbia, and later in the summer of the same year it was used on 606 trees on one study area near

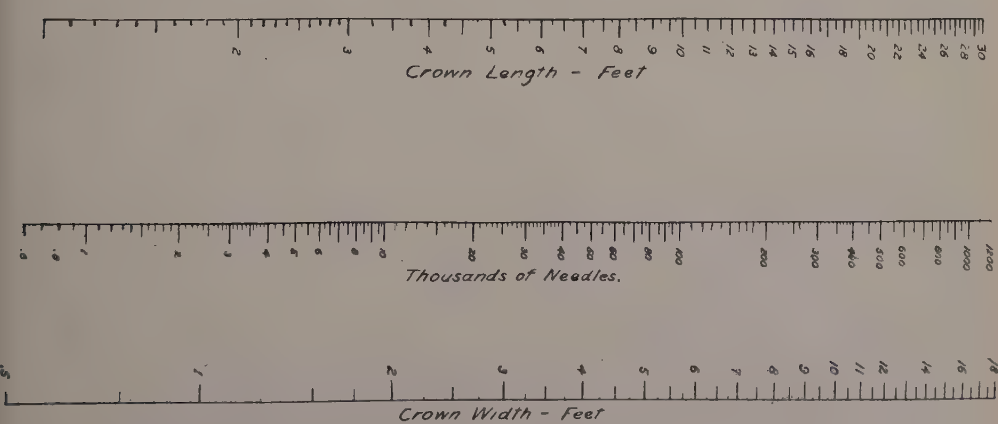

Fig. 1.—The relation between crown length, crown width, and number of needles on western white pine reproduction.

Clarkia, Idaho. In 1935 it was checked with and found to be applicable to white pine reproduction near Bovill, Idaho, and consequently it is being used to determine the number of needles on some 20,000 trees on study plots in that locality. The principal advantages are that it greatly speeds up the field work and eliminates the errors likely to be incurred by the personal factor. Its use in the field, moreover, is not restricted to absolutely normal trees. For trees with broken or misshapen crowns, measurements can be taken as usual and then a correction factor indicated, as determined by ocular estimate. This correction factor is then applied to the number of needles designated when the field data are scaled from the chart in the office.

Crown density of the trees used as a basis for this chart was not measured in concrete terms. The influence of density was not entirely disregarded, however, as needle retention data were secured. The density of a coniferous crown is apparently closely correlated with variations in needle retention. This influence of length of needle retention on numbers of needles is also cared for by the application of a correction factor. Most of the shedding of needles in *P. monticola* normally occurs in late summer and fall. Table 2 gives the needle retention on the average tree for the seven areas on which the basic data were secured, as determined during the progress of the study by actual counts and ocular observations in the fall during the seasonal shedding of needles.

Table 2

NEEDLE RETENTION ON THE AVERAGE TREE MEASURED

Age of wood	Per cent needle retention on indicated portion of crown. Lower	Upper	Leader	Average
Current	100.0	100.0	100.0	100.0
1 year	100.0	100.0	97.5	99.8
2 years	90.0	64.2	6.0	73.0
3 years	7.2	trace	trace	4.2
4 years	1.0	0.0	0.0	0.1
5 years	trace			0.0
6 years	0.0			

Obviously, the shorter the needle retention the fewer the needles present, other factors remaining constant. Before application, then, needle retention would have to be determined for the group of trees under consideration; and if not within reasonable agreement with the data of Table 2, a correction factor would have to be arrived at.

Conclusions

1. There is a relationship between length and width of crown and number of needles on western white pine reproduction capable of expression by means of a simple alinement chart.
2. The use of such a chart greatly reduces the time required in the field on studies wherein it is desirable to know the number of needles on western white pine reproduction. By using the chart systematically errors due to personal bias are eliminated, and non-systematic errors for groups of trees are brought within reasonable limits.
3. The number of needles on western white pine trees, regardless of the trees' condition, can be determined by this chart. The number of needles on a normal tree can be read directly. With abnormal trees a correction factor can be indicated in the field and then applied to the needle data as scaled off in the office.

Summary

A total of 6,809 measurements of crown length, crown width, and number of needles on young western white pines were made in British Columbia following the 1928 and the 1930 seasonal development. Of this total, 2,923 measurements of trees which were found to be normal in every respect were used in the con-

struction of an alinement chart by the harmonized curves method. This chart permits the determination of number of needles when only crown length and crown width are known. Checking the chart statistically showed the aggregate difference to be 1.43 per cent low, and the average deviation to be 39.5 per cent, indicating that good results can be secured when measuring large numbers of trees, but that results for individual trees are not too reliable.

It is not desired that this chart, in its present form, be accepted as infallible. It does indicate possibilities, however, and with proper usage and the application of correction factors as required, reasonable accuracy may be secured. No attempt has been made to test its usability over a wide geographic range, but no factors appear to be present which would totally prohibit its use if the influencing variables were properly recognized and evaluated.

Rules of Thumb for Log Scaling

Two rules of thumb for log scaling have recently appeared in the Journal of Forestry, one for the Scribner Decimal C Log Rule, by W. R. Becton,[1] the other for the International ¼-Inch Rule, by J. C. Sammi.[2]

Although the sole purpose of a rule of this kind is to give the woodsman a fair approximation of the scale of logs when no log-rule table or scale stick is available, it should be accurate enough to command respect and to justify memorizing it. Becton's rule is too inaccurate to be of much practical value, and Sammi's consistently underruns the true scale.

The following rules of thumb are therefore suggested for use, as they meet the requirement of accuracy more fully than do either of the above rules.

1. Scribner Decimal C rule of thumb, 16-foot logs:

$$V = \frac{2d}{10}\left(\frac{2d}{5} - 1\right)$$ where d = top diameter of the log in inches and V board foot content.

The rule reads: "Double the diameter, divide it by 5, and subtract 1; multiply the result by twice the diameter and divide the product by 10."

For example, the scale of a 20-inch log is 4 (8 — 1) = 28 board feet in tens, or exactly what the Scribner Decimal Rule shows. According to Becton's rule it is only 26.4. Similarly, a 40-inch log will have 8 (16 — 1) = 120 board feet in tens, or the same scale as given by the Log Rule. Becton's rule, on the other hand, is not even capable of giving the board-foot content of this log, since it breaks down completely for logs larger than 27 inches.

2. International ¼-inch rule of thumb, 16-foot logs:

$$V = 2d\left(\frac{2d}{5} - \frac{3}{4}\right)$$, when again d = top diameter of the log in inches and V board-foot content.

The rule reads: "Double the diameter, divide it by 5, and subtract ¾; multiply the result by twice the diameter."

As an illustration, a 20-inch log will scale 40 (8 — ¾) = 290 board feet, which is the exact scale. Sammi's rule gives 288 board feet for a log of this size.

If the scale by the International ⅛-Inch Log Rule is required, it can be obtained by multiplying the scale as obtained above by 1.11. Thus, the scale of a 20-inch log by the International ⅛-inch Rule is 290 × 1.11, or 322 board feet.—S. R. Gevorkiantz, *Lake States Forest Exp. Sta.*

[1] Vol. 34:110.
[2] Vol. 34:181.

FOREST FIRE CONTROL IN NORTH CAROLINA

By W. C. McCORMICK

North Carolina Department of Conservation and Development

The Division of Forestry in the Department of Conservation and Development is the agency designated by law to supervise forest fire control work in North Carolina. Two methods are employed: cooperation with counties, and cooperation with timberland owners in either a cooperating or a noncooperating county. Fifteen million acres, or about 75 per cent of the forested area of the state, are now afforded protection. The article describes how the control work is organized under this system of cooperation.

A LAW, enacted in 1935 by the North Carolina legislature, broadens the powers of the State Forester and permits the establishment of a fire control organization in any county in which, in the State Forester's estimation, based entirely upon existing fire conditions and the timber values at stake, fire control is necessary. If and when the State Forester determines that a fire control organization should be established in a county, it is mandatory that the county provide one-half the funds necessary for the proper protection of that county's woodlands in an amount not to exceed ½ cent per acre of forested area. The sum so designated by the State Forester is matched by an equal amount of state and federal funds, thereby allowing not to exceed 1 cent per acre for this work.

Previously, county cooperation was voluntary, and those cooperating had to fight fires from adjoining noncooperating counties. However, though 12 new counties entered into cooperation after the law was passed, some of them possibly because of the law, in no instance was it necessary to force cooperation.

The number of cooperating counties has increased from 32 in 1934, several of which were inactive a portion of the year because of lack of sufficient appropriation, to 56 counties in the spring of 1936. From July 1, 1934, to date no counties have dropped out, nor have their funds become depleted due to an insufficient appropriation. No county has been indebted to the state for a longer period than 60 days.

Organized by Districts

North Carolina was redistricted in 1934 to embrace seven forestry districts, the boundaries of which were set up to include, as nearly as possible, similar forest types, topography, and fire conditions. Six of these districts are supervised by technically trained, experienced foresters, assisted by nontechnical district forest rangers and clerk-stenographers. With one exception district headquarters are located in federal buildings. A seventh district was set up embracing the Piedmont region, where no work is at present being done and where intensive fire control will never be put into effect because of the large amount of cleared land and small amount of inflammable woods. It is planned to conduct extensive work in these counties when funds will permit.

Since the summer of 1935, 12 noncooperating counties within these several districts, in which it was deemed that fire control was necessary, were taken into the organization, and the counties so selected were chosen in a manner that would block up the entire coastal plain and sandhill sections from Virginia to South Carolina. As soon as agreement forms were signed, an organization was immediately formed.

A county warden, who is usually a taxpayer and who is not only an outstand-

ing substantial citizen but also more or less versed and interested in forest conservation, is selected to head up the work in each county. He is paid on a yearly basis, and is required to devote his entire time to the work. We have found, in the main, that a man about forty years of age, preferably a woodsman and timberland owner, makes the best county warden. His salary ranges from $60 to $140 per month, the average being around $100. When county appropriations are available, the county wardens are furnished with a state- and county-owned half-ton pick-up truck, fully equipped with fire-fighting paraphernalia and with a carrying capacity sufficient for ten men. Many of these trucks are also equipped with centrifugal pumps and reserve water supplies of from 75 to 100 gallons.

After the county has been divided into fire districts, averaging about 1,400 acres of timberland to each district, a district warden for each of these fire districts is recommended by the county warden. The district forester or district ranger, in company with the county warden, interviews each of these proposed district wardens and, if in the opinion of the district office the man so recommended is suitable, he is duly appointed and has all of the power of a state forest warden. A district warden devotes as much of his time to the work as is necessary to handle the fire control problem in this territory. He is paid on an hourly basis, at the rate of 30 cents per hour for the time he actually devotes to fire control.

Each district warden sends to the district forester a list of from two to five men who have signed a pledge to respond to any call from the district warden for service as fire fighters. These "pledged" crews receive 20 cents per hour. Usually the men are tenants on the district warden's farm. When a fire is reported to him, he rings a bell or gives some other agreed-upon signal, and his crew meets him at once and is taken to the fire. Each district warden is supplied with sufficient fire-fighting equipment to outfit his crew; some are supplied with fire-fighting trailers.

Deputy wardens are no longer appointed. Originally a large number of deputy wardens were appointed, on the theory that, if a sufficient number were available, no fire could start that was not acted upon by at least one of them. This plan did not work because each man felt that it was the other man's job.

During the peak of the fire season, when we deem it necessary crews of from two to five men, called "firemen", are employed at a small monthly wage. These men remain at a fire tower for immediate call. When a fire is discovered, if it is within their territory they are immediately dispatched to it in an automobile owned by one of the crew, who is a district warden and foreman of the crew. After fighting a few fires these men become fairly efficient. Since they do not have to work when no fire is burning, it is quite natural they work more effectively when they are fighting fire, which results in a smaller acreage destroyed.

Fire Detection System

There are at present 66 lookout towers and five water tanks and tall buildings used for fire detection purposes. All these observation stations are connected by telephone, and all county wardens are tied into these lookout points where possible. We have at present over 600 miles of state-owned telephone lines, and are constantly constructing additional lines. We connect with commercial lines where possible. We have estimated that it will require 120 towers and approximately 1,200 miles of telephone lines to give us the desired detection and reporting facilities.

During the main fire seasons, which normally run from October to the mid-

dle of December and from February until the first of June, the lookout points are manned by towermen. They are equipped with properly oriented maps, alidades, and telephones. At all the towers there are houses, and at all except the mountain towers there are garages and storerooms for the use of the towermen.

Many of the towermen live at the tower houses, and are employed on a yearly basis. The sum paid them monthly is equal to the amount that would be paid them during the fire season by distributing it over a 12-month period. These towermen are usually married men with families. Arrangements are being made as rapidly as possible for their comfort and convenience. The sites are being fenced and developed, and gardens are provided for their use. Although they are paid for the entire year, they are at liberty to do any other work they wish during the periods when their services are not necessary on the towers; but by living there throughout the year they are available for service any time we need them, and the vandalism that is encountered at unoccupied towers and tower houses during off-fire season is eliminated. This procedure allows us to hold trained towermen, and so stabilizes the organization.

During the peak of the fire season county wardens patrol their counties. When a man is found who is preparing to clear some "new ground", he is not only cautioned by the county warden, but asked for the approximate date when he expects to burn. The county warden then indicates on the tower map the location of this proposed burning, and tells the towerman the date. Because of this precaution the brush burner is more careful with his land-clearing operations, and the field force is saved many miles of unnecessary travel going to what are commonly known as "legal fires".

Temporary fire fighters are employed only when the regular organization cannot handle a situation. They are paid 10 cents an hour only, but very few are employed. C.C.C. labor is used only when the regular warden organizations are unable to handle large fires.

Our aim is to develop a trained fire-control organization, and from the results obtained since the present system was put into effect it is apparent that we are making progress.

Forest Protective Organizations

In addition to the plan of county cooperation, individual timberland owners or groups of timberland owners may list with the state their holdings in blocks of not less than 30,000 acres. The assessment rates on these lands vary according to what we consider necessary to give them proper protection, and range anywhere from 1 to 10 cents per acre, which, of course, is matched by an equal amount of state and federal funds. At present 13 protective associations, embracing approximately 400,000 acres owned by 75 landowners, are active.

These cooperators sign a regular agreement form, and pay their assessments in advance. The funds are deposited and used as we deem advisable. In every protective association there is at least one association ranger who devotes his entire time to work on the association properties, and who is employed on an annual basis. Towers are constructed and manned during the fire seasons, and roads, trails, and fire lines are constructed and maintained. Caterpillar tractors, Hester plows, disc harrows, and road machines are purchased from association funds for the construction and maintenance of E.C.W. and other improvements, including telephone lines. The major portion of E.C.W. construction is centered in these association holdings.

In one protective association, embracing 54,000 acres, we have been plowing fire lines to supplement those originally

constructed by E.C.W. labor, and thus subdividing the area into blocks smaller than the 2,500 acres allowed by E.C.W. regulations. More than 300 miles of such fire lines were plowed last winter.

Fire-Fighting Equipment

In North Carolina we find the following hand equipment most satisfactory for our needs: D. B. Smith Indian fire pumps with five-gallon water supply tanks, Council fire rakes and brush hooks, fire swatters, single-bit axes, long-handled shovels, railroad fuses for backfiring, 12-quart buckets, and lanterns.

We have 35 half-ton trucks in service, the majority of which are equipped with 75-gallon water reserve tanks and motor-driven centrifugal pumps for filling and discharging the tanks under pressure, with sufficient hose to be carried on them to a fire or used from the trucks while they are in motion, and sufficient fire-fighting equipment for 10 fire fighters. Each truck has a carrying capacity of 10 men. We have 60 two-wheel trailers which may be attached to the rear of wardens' cars, and which carry sufficient tools for 10 men and a 55-gallon reserve tank.

In one place we are using a light caterpillar tractor and fire-line plow which, when needed, can be hauled on a Ford truck to the fire, where a fire line may be plowed at the burning edge. This tractor is used for fire-line and road maintenance when not on fire control work.

Discussion of Efficiency

Fifteen million acres, or 75 per cent of the forested area of North Carolina, are now under protection. Of this area 400,000 acres are under "double protection" because included in protective associations. The average forest district has an area of approximately 2½ million acres and is supervised by the district office personnel of 2 field men.

Summing up the organization, we have 6 district foresters, 6 district rangers who are nontechnical men promoted from the warden organizations, 6 district clerk-stenographers, and 56 county wardens. We have a year-long organization, including association rangers and towermen living at the towers, totalling more than 100 persons. In addition we have approximately 250 seasonal employees, such as part-time towermen, firemen, and patrolmen. The district wardens and their pledged crews bring the total personnel under appointment to approximately 1,200.

Time and careful study have proved that under the present arrangement, which of course does not guarantee "asbestos" protection, the average of about 2 cents per acre enables us to secure satisfactory results. We do not believe that it will ever be necessary for us to request more than 4 cents per acre, and then only where much more intensive protection is desired and where the assistance of the general public can be depended upon as under the present set-up.

The writer realizes quite fully that the foregoing statements regarding the cost of protection may be challenged, but it must be remembered that he refers only to North Carolina. He does not believe it is necessary to provide more funds than can be advantageously and effectively expended. Nor does he believe that, until the time comes when the state, through larger appropriations, assumes the sole responsibility for state-wide protection, need we spend in excess of 4 cents per acre in the protection of the growing forests in North Carolina.

Furthermore, the writer believes that the landowner should be forced to assume some responsibility for the protection of his own lands, and that, if the state is willing to meet him half way by organizing and supervising the work, he is doing only what is fair to all by providing his share of half the costs.

THE MAKING OF A FOREST TYPE MAP OF THE PACIFIC NORTHWEST

By R. W. COWLIN

Pacific Northwest Forest Experiment Station

THE rapidly expanding development of land-use planning, in which foresters have played a prominent part, has emphasized the importance and necessity of cover type maps. As a result of the national forest survey, forest cover type maps of the Pacific Northwest will be available when current projects are completed.

Field procedure and problems involved in the production of cover type maps and the many uses of the finished maps have been discussed by Andrews[1] and Wieslander.[2] A very necessary step in the production of finished maps is the preparation from the field sheets of map copy for the printer or lithographer. This involves many problems in drafting and map technic. The experience of the Pacific Northwest Forest Experiment Station in this connection may contain information of value to others interested in similar projects.

When the forest survey was commenced in the Douglas fir region of Oregon and Washington, it was decided to make type maps of the entire region. Some 39 types were defined and mapped in the field, and in addition the immature coniferous types were further subdivided by age in 10-year classes and three degrees of stocking. Maps were made, scale 1 inch to the mile, of each of the 38 counties and 11 National Forests in the Douglas fir region. These maps preserved the detail mapped in the field. Each type was shown by number, and the age class and stocking of the immature types were shown by numbers and symbols. The 38 county maps totaled 971 square feet.

It was out of the question to lithograph these maps for public distribution because of the size and cost, but there was sufficient demand to justify publication in a less expensive form. A skeletonized map giving sufficient base detail for orientation was made on tracing cloth for each county. From this a brown line print was made, on which the type boundaries and symbols were traced from the township field sheets by means of a light table. A Vandyke negative was made from the brown line print and used to make blue line prints. A color legend was devised, using solid colors for the mature types, hatching and cross hatching in the color adopted for the parent type for the second-growth types, and various conventional designs for miscellaneous types. Several sets of these maps were hand-colored for the use of the Experiment Station, the Regional Forester's Office, and the Supervisors of the National Forests. A number of other public agencies, lumber companies, paper pulp companies, and forest engineers had copies of these maps prepared at their own expense. These maps were valuable for intensive study; but the expense of reproducing and coloring them prevented their wide public distribution.

For general use it was decided to publish colored lithographed maps containing sufficient type detail to present the broad aspects of the forest situation. The scale of ¼ inch to the mile was adopted,

[1]Andrews, H. J. The forest survey in the Douglas fir region. Jour. For. 30: 264-275. 1932.
[2]Wieslander, A. E. First steps of the forest survey in California. Jour. For. 33: 877-884. 1935.

and it was decided to divide both Oregon and Washington into quarters, each quarter at this scale being a convenient wall size (approximately 40 inches by 54 inches). Such base maps were not available, and it was necessary to compile and draft maps of both states. Since the principal purpose of this map was to act as a base for the colored type map, it was designed accordingly. Only the principal streams, highways, and towns were shown, in order not to obscure the type data when colored. Counties, National Forests, National Parks, and Indian reservations were outlined and named on the map. The smallest land subdivision shown was the township. Cultural detail was shown in black, and water in blue. The title and legend were so placed that the maps could be used alone, or mounted into half or entire states. There was considerable demand for this map as a base map, and approximately 1,000 copies of each quarter were distributed. These maps were lithographed by the U. S. Geological Survey.

At the same time that this edition was printed, about 25 copies of each quarter were printed in nonphotographic blue ink on heavy chart paper, to be used later in making the colored lithographed type map.

The first step in the preparation of the type maps was to decide upon a type legend. Since this was to be a state type map, there could be no duplication of colors between types of the Douglas fir and the ponderosa pine regions. In the Douglas fir region 39 types were recognized, in the ponderosa pine region 39, with some overlap between the two regions. In all there were 50 distinct types. It was impractical to show all on the final map, and some were combined and the number reduced to 25. A legend, either solid color, hatching, or design, was assigned to each of these types. The same general principles were used as in the color legend for the 1-inch-to-the-mile maps. The solid colors represented the mature types, the hatching the second-growth types; green was used for Douglas fir types, orange for ponderosa pine, purple for spruce-hemlock, and blue for upper slope mixed conifers; shades of red were used for lands deforested by fire or cutting; hardwoods were shown in gray, and the nonforest land types in buff.

Next a vellum overlay was prepared for each county, scale of 1 inch to the mile, showing township boundaries only. This was superimposed over the colored county maps, and the detailed types were combined and generalized and traced in pencil on the vellums. After careful checking, the vellums were reduced photographically to ¼-inch-to-the-mile scale and prints made. The prints were intensified by inking in red. These were lightly traced in pencil on the chart paper maps. This process was again checked, and then the type boundaries and numbers were inked in with a fine pen. Numbers were not shown in each small type area, but were shown often enough so that it would not be necessary to rely on the color alone to tell the type. The type lines were extended about one-sixteenth inch beyond the limits of the map, so that the adjoining quarters could better be matched.

The map was then sent to the U. S. Geological Survey for photographing. The maps were carefully handled to avoid creases or folds, which would photograph as a line. When photographed, only the type lines and numbers showed. The products are called type boundary maps. A number of these were returned to be colored. Eight basic colors were to be used in the lithographing, and one type boundary sheet was colored for each of the eight. On each of these sheets the types were colored that took that particular basic color on the final map,

either solid, in combination, or design. In coloring the type areas a legend was made for each color run sheet, a separate color being used for each type that took this color. Finally a master color sheet was prepared in which all the types were colored, using solid colors and designs. These were checked and sent to the U. S. Geological Survey for the final lithographing. After the color plates were engraved, copies were printed and sent back for correction. This done, the map was ready for the final printing.

An edition of 3,000 copies is now being printed for each of the western quarters of the two states, which includes all of the Douglas fir region and part of the ponderosa pine region. These will be sold at a price approximately equal to the cost of reproducing the map, or about $1 per copy. A limited number will be distributed without charge to cooperating agencies. Advance inquiries indicate that the maps will sell readily. The users of the map will include public agencies having to do with forestry and land use planning, lumber companies, pulp and paper companies, transportation companies, public utilities, financial institutions, chambers of commerce, and educational institutions.

SOME FACTORS INFLUENCING DOUGLAS FIR REPRODUCTION IN THE SOUTHWEST

By HERMANN KRAUCH

Southwestern Forest and Range Experiment Station

DOUGLAS fir cut-over areas in the Southwest are, as a rule, restocking too slowly to meet the requirements of good silviculture. This is particularly true of the southern mountains, such as the Sacramentos and the Grahams, where the best stands of Douglas fir in the region occur. Although the problem is partially solved in places by advance growth of poles and saplings, this is seldom so in the denser stands. On Forest Service cuttings, now up to 20 years old, it is unusual to find seedlings started since cutting in sufficient numbers to give the density required to produce high-quality sawtimber. On the other hand, on some of the older private cuttings restocking has been surprisingly good, despite the fact that very few seed trees were left and the areas often burned over as well. Although in these instances the influence of the time element is to be considered, the results do nevertheless seem to indicate that something is lacking in the present silvicultural practice.

In 1923, plots were established to represent different methods of cutting, namely, light selection, shelterwood, diameter limit, and scattered seed tree methods. During the 12-year period that has elapsed, three good and several light seed crops have been borne and rainfall has been near normal. Some seedlings have become established, but the number has not been adequate under any of the four methods of cutting, nor has the method of cutting shown evidence of affecting reproduction. The poor results have been due less to deficient germination than to poor survival. Although records were kept on seedling plots, examinations were not sufficiently frequent and detailed to ascertain the dominating factors responsible for the high mortality.

Purpose and Scope of this Investigation

In 1932 the problem was attacked anew, placing special emphasis on isolating the various influences concerned. Several factors thought to have a direct bearing on the results were placed under artificial control. These were seed supply, rodents, grazing, seed bed, shade, and root competition. The study was carried on in the vicinity of Cloudcroft, New Mexico, where Forest Service and private cuttings are intermingled and afford an opportunity for observation under a great variety of conditions.

Experimental areas were divided into three sections, one fenced to exclude both rodents and cattle, a second fenced to exclude cattle but not rodents, and a third left open to both. On each of these divisions seed was sown by hand in measured quantities on meter-square plots. Plots mulched with various kinds of leaf litter were paired with plots in the open. To study the effect of shade without tree-root competition, some plots in the open were covered with lath screens suspended about 14 inches above the ground and affording from ¼ to ½ overhead shade. On most plots the soil was loosened to a depth of 2 or 3 inches, the herbaceous cover removed, and the seeds covered with a thin layer of loamy topsoil. On other plots the seed was simply scattered on the undisturbed ground and left undercover. In a few of these latter plots

the roots of the herbaceous vegetation were cut but the plants were not removed.

Seed was sown in early summer and fall. Since germination normally occurs only with the summer rains, which may begin any time between June 1 and July 15, nothing was to be gained by spring sowing as compared with summer sowing. The object of sowing in the fall was to stimulate the conditions to which seed from natural fall is normally subjected. Each seedling was marked with a toothpick as soon as it emerged from the ground. Examinations were made daily until germination was completed, and at somewhat less frequent intervals throughout the first growing season. In this way only could the causes of death of new seedlings be ascertained. In order that a complete record of the surviving seedlings might be maintained, the seedlings found to be alive at the end of the first season were marked with numbered pot labels. Sowings were made in three different years, namely, 1932, 1933, and 1934. In 1934 sowing in plots was supplemented by sowing in narrow strips. The advantage of strips is that they cover a greater variety of conditions and at the same time keep the area down to a minimum.

Results

Tables 1 to 3 give the results under different conditions in 1932, 1933, and 1934. Since the same quantity of seed (about 40 seeds per square foot) was

Table 1

RESULTS[1] OF PLOT SOWING ON NORTH AND SOUTH SLOPES. SIZE OF PLOTS 1 X 1 METER

Type of protection	Average number of seedlings per plot on different dates: Aug. 1932	Oct. 1932	Apr. 1933	Oct. 1933	Apr. 1934	June 1934	Oct. 1934	Survival Oct. 1934	Number of plots
	No.	No.	No.	No.	No.	No.	No.	Per cent	No.
	Sowing of June, 1932—north slope								
Rodent exclosure	74	63	58	31	29		23	31.1	16
Cattle exclosure	8	4	3	2	1		1	12.5	16
Unprotected	9	3	2	1	0.2		.07	0.8	15
	Sowing of October, 1932—north slope								
	Aug. 1933								
Rodent exclosure	77			48	39	30	22	28.6	23
Cattle exclosure	61			15	7	5	3	4.9	26
Unprotected	58			14	7	5	2	3.4	22
	Sowing of October, 1933—north slope								
	Aug. 1934								
Rodent exclosure	31						4	12.9	16
Cattle exclosure	7						2	28.6	19
Unprotected	12						3	25.0	17
	Sowing of June, 1934—south slope								
	Aug. 1934								
Rodent exclosure	51						14	27.4	10
Cattle exclosure	11						0.6	5.5	10
Unprotected	15						0.6	4.0	10

[1]Number of seedlings per plot given to nearest whole number, except where average is less than 1.

Table 2

RESULTS OF STRIP SOWINGS ON NORTH AND SOUTH SLOPE EXPERIMENTAL AREAS

Type of protection	Original seedlings per 10 ft.	Survival October, 1934		Length of strip
	No.	No.	Per cent	Ft.
Sowing of June, 1934—north slope				
Rodent exclosure	26.9	16.2	60.2	170
Cattle exclosure	5.7	2.6	45.6	230
Unprotected	4.0	1.6	40.0	260
Sowing of July, 1934—north slope				
Rodent exclosure	17.6	10.5	59.6	170
Cattle exclosure	4.4	2.4	54.5	230
Unprotected	3.6	2.7	75.0	260
Sowing of June, 1934—south slope				
Rodent exclosure	8.7	1.4	16.1	140
Cattle exclosure	4.7	0.5	10.6	140
Unprotected	3.6	0.0	0.0	140
Sowing of July, 1934—south slope				
Rodent exclosure	3.8	0.9	23.7	140
Cattle exclosure	4.0	1.9	47.5	140
Unprotected	4.1	0.8	19.5	140

Tabe 3

RESULTS[1] AS RELATED TO DIFFERENT CONDITIONS OF HERBACEOUS VEGETATION AND OF SHADE AND MULCH. (BASED ON PLOTS SOWN IN OCTOBER, 1932, IN NORTH SLOPE RODENT EXCLOSURE.)

Location and treatment of plots	Aug. 1933	Oct. 1933	Apr. 1934	June 1934	Oct. 1934	Number of beds
	No.	No.	No.	No.	No.	No.
Vegetation removed						
Natural shade, mulch	114	73	64	53	39	3
Natural shade, no mulch	141	102	85	55	36	4
Lath shade, mulch	91	49	45	44	36	3
Lath shade, no mulch	95	59	42	41	37	3
In open, mulch	33	12	9	7	4	4
In open, no mulch	51	32	15	14	7	2
Roots cut						
In open	48	33	24	8	0	1
No soil preparation						
In open	7	5	4	1	0.7	3

[1]Number of seedlings per plot given to nearest whole number, except where average is less than 1.

sown on each plot, seed supply is not a variable. As may be seen from Table 4, precipitation in the summer of 1932 and up to July, 1933, was above normal, whereas after June, 1933, it was below normal. This probably explains the better germination and survival in 1932 and 1933 than in 1934. It should be noted, however, that even with the subnormal precipitation during the germination period (July and August) of 1933 and 1934, fairly good results were obtained. The relation of other factors to germination and survival is discussed in the following pages.

The influence of rodents is outstanding throughout the series of sowings. In fact, this influence is so strong that it might almost be said that, given average precipitation and good seed supply, seedlings will become established wherever rodents are excluded but in no place where they are present. Not only do they eat the seeds but they also cut off the cotyledons and stems for several weeks after germination. The rodents

TABLE 4

MONTHLY AND SEASONAL PRECIPITATION AT CLOUDCROFT, N. M., ELEVATION 8350 FEET, AND DEVIATIONS FROM AVERAGES DURING PERIOD OF THIS STUDY

Year	Month	Precipitation		Deviation from 10-year average (1915-1924)		Deviation from 20-year average (1915-1934)	
		inches	inches	inches	inches	inches	inches
1932	June	2.25		+0.43		+0.75	
	July	5.79		+1.20		+0.66	
	Aug.	6.80		+2.07		+1.44	
	Sept.	3.72		+1.22		+1.15	
			18.56		+4.92		+4.00
	Oct.	3.21		+2.02		+1.55	
	Nov.	0.00		—1.14		—1.27	
	Dec.	2.56		+1.39		+1.20	
1933	Jan.	3.04		+1.29		+1.46	
	Feb.	2.69		+1.50		+1.25	
	Mar.	0.48		—1.16		—1.18	
	Apr.	0.52		—0.62		—0.37	
	May	2.15		+1.49		+0.78	
			14.65		+4.77		+3.42
	June	3.61		+1.79		+2.11	
	July	3.56		—1.03		—1.57	
	Aug.	3.33		—1.40		—2.03	
	Sept.	1.10		—1.40		—1.47	
			11.60		—2.04		—2.96
	Oct.	1.32		+0.13		—0.34	
	Nov.	0.89		—0.25		—0.38	
	Dec.	0.05		—1.12		—1.31	
1934	Jan.	0.40		—1.35		—1.18	
	Feb.	0.40		—0.79		—1.04	
	Mar.	0.83		—0.81		—0.83	
	Apr.	0.49		—0.65		—0.40	
	May	1.85		+1.19		+0.48	
			6.23		—3.65		—5.00
	June	0.25		—1.47		—1.25	
	July	4.01		—0.58		—1.12	
	Aug.	3.08		—1.65		—2.28	
	Sept.	0.60		—1.90		—1.97	
			7.94		—5.70		—6.62
	Oct.	1.00		—0.53		—0.66	

most directly concerned are the Rocky Mountain meadow mouse (*Microtus mordex mordex*) and the tawny deer mouse (*Peromyscis maniculatus rufinus*).[1] The meadow mouse is thought to be the chief offender in biting off young seedlings, while the tawny deer mouse is the biggest seed eater. Spruce squirrels (*Sciurus fremontii lychnuchus*) are active mainly in cutting cones from the trees. Occasionally they have gained access to the rodent exclosure but have left no evidence of disturbing seed or seedlings. The fulvous pocket gopher (*Thomomys fulvous fulvous*) kills seedlings by burrowing underneath them or covering them with earth. Of birds the most troublesome is the junco (*Junco* sp.), which picks up seeds from the ground and also removes the seed caps and cotyledons of newly germinated seedlings.

Although areas open to cattle were very heavily grazed, no direct evidence of grazing damage was found. Since rodents also have access to the plots grazed by cattle, it is likely that all possibility of damage by cattle was precluded by previous destruction of seedlings by rodents. But examination of extensive areas in the Cloudcroft district reveals little evidence of browsing coniferous seedlings. Trampling might be a factor, particularly on slopes where loosening of the soil in dry periods may cause excessive soil movement.

Mulching with needle litter appears to have had rather inconsistent effects. Except in the dry summer of 1934, germination within the rodent exclosure (Table 3) has been best on bare ground. On plots accessible to rodents, however, the presence of litter apparently interferes with rodents finding the seeds. In its effect on soil moisture, litter may act in different ways. It may prevent light showers from reaching the soil, but it undoubtedly also retards evaporation after the ground has become soaked by heavy rains. Generally it tends to lower surface soil temperatures, and thus may retard germination. That the effect of mulch should vary with different conditions and that these are influenced by the character of the season is to be expected. There have been indications that seedlings, once established, survive better when mulched. A thin litter is preferable to a thick one, and litter from broadleaf trees has been found to be more effective than that from conifers.

It is evident from Table 3 that loosening the surface soil and removal of vegetation, together with covering the seed, greatly favored germination. Even in the plot designated "roots cut only" the scarification incident to cutting the roots appears to have created conditions more favorable to germination than where the soil was wholly undisturbed. The subsequent high mortality where only the roots were cut is probably attributable to reestablishment of the herbaceous vegetation.

Light or moderate shade appears, in general, to have favored both germination and survival. The effect on germination may be interpreted as due primarily to reduction of evaporation from the surface of the soil. Considering the well-known sensitiveness of young Douglas fir seedlings to direct exposure to the sun, shading may be expected to have a beneficial effect. It is significant, however, that even though survival was lower on the unshaded plots a fair number of seedlings persisted, and judging from their appearance in the second and third years, most of them will survive. Shade is, therefore, to be looked upon as beneficial, primarily because it retards transpiration during the tender stages of seedling development.

Root competition may came from older

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[1]Identifications of these and other rodents and birds mentioned in this article were made by Dr. Walter P. Taylor, U. S. Biological Survey.

trees or from herbaceous vegetation, or both. When seedlings of a relatively tolerant species, such as Douglas fir, die or grow poorly near older trees, it is usually taken for granted that root competition rather than shade is the adverse factor. Thus far, however, seedlings on plots located within the intensive root zone of large, high-crowned Douglas firs have not shown consistently ill effects. Herbaceous vegetation appears to offer more competition than shrubs or trees. On some of the plots within the rodent exclosures, herbaceous vegetation has become very luxuriant, and all or nearly all of the Douglas fir seedlings have passed out or show evidence of suppression. Where weeding has been practiced, it has proven beneficial. The fact that some seedlings are virtually covered by herbage suggests that light as well as root competition may be important. Opposing this conception, however, is the observation that mortality has been less on grass-grown plots that are partially shaded by lath than on those that are not shaded. This may be due to lowered transpiration and, thus, a lower total water consumption under the lath shades.

The reasons for the failure of seedlings to survive after germination are to a large extent self-evident from the preceding discussion. In the plots open to rodents, the cutting of stems or cotyledons is responsible for the death of nearly 60 per cent of the seedlings, this in addition to the destruction of seed before germination. In rodent exclosures the greatest mortality is associated with drought, either in the form of high water loss, causing the sudden wilting of young seedlings, or in the form of slow failure due to declining soil moisture. In the plots exposed to rodents the loss in these two classes is relatively low, probably because most of the seedlings were bitten off before drought became critical. Soil heaving due to frost action is important only on unshaded plots, and here a soil mulch has proven beneficial.

Application to Forest Practice

The foregoing experiments have demonstrated that by safeguarding the seed supply against rodents, preparing a suitable seed bed, eliminating excessive root competition, and providing the right degrees of light and shade, reproduction of Douglas fir is virtually assured. It goes without saying that occasional years of deficient moisture or other adverse climatic factors may render the above measures temporarily unavailing; but records indicate that over a long period of years the climate is rarely an unsurmountable obstacle. The intensive control practiced in this experiment, however, virtually amounts to artificial reforestation. The problem is to determine in what measure the desired results can be attained by such aids as are possible in the course of practical forest management.

Rodent control appears to be foremost among the measures listed. The results in Tables 1 and 2 indicate that without effective protection against mice, success cannot be expected. On the other hand, one must not overlook the fact that on many areas natural reproduction has taken place in spite of rodent activity. In this experiment, a limited quantity of seed on a small area was exposed to the rodent population of large surrounding areas. In years of good natural seedfall the seed supply over extensive areas may be adequate to feed all the rodents and still leave enough for reforestation. There is abundant evidence that this may occur in both the pine and the Douglas fir forests. Trapping experiments by Walter P. Taylor of the Biological Survey in the vicinity of these experimental plots indicate that mice are much more numerous on cut-over areas than in uncut timber or in aspen stands. These findings suggest the possibility of silvi-

cultural control of rodents as well as trees. It is well known that down logs and brush harbor small rodents, and that heavy cutting decreases the net seed supply. It thus appears that cutting might be so regulated as to avoid throwing the balance too much on the side of the rodents. Where old burns have restocked, destruction of rodents by fire probably has figured prominently in forest regeneration. Temporary reduction of rodents by poisoning or other means would undoubtedly aid tree reproduction, but before undertaking an extensive campaign it is desirable to ascertain what can be accomplished by silvicultural control.

Creation of a good seed bed involves primarily placing the seed in contact with mineral soil. It also implies covering the seed and removal of excessive herbaceous vegetation which may rob the tender tree seedlings of needed moisture and insolation. But intensive soil culture, to be effective, should be accompanied by artificial seeding and rodent control, and thus the operation becomes virtually one of artificial reforestation. To keep within the field of natural reproduction and economic limitations, soil culture must, in the main, be limited to such measures as can be brought about incidentally in logging operations, brush disposal, and grazing. Logging scarifies the soil and stirs up the litter. Brush burning may be employed to remove excessive leaf litter, while judicious scattering of brush will relieve bareness. Grazing helps to reduce competition from herbaceous vegetation and aids in covering seeds, but it should not be permitted to go to such extremes as to induce heavy soil movement on slopes or packing in valleys. Natural agencies which aid in covering seeds are leaf litter, soil checking, freezing and thawing, movement of soil by water and wind, trampling by animals, and to some extent planting by rodents. Needless to say, the processes that have been mentioned are less effective than well directed and properly timed cultural operations.

Removal of tree-root competition and regulation of light and shade can within certain limits be accomplished simultaneously by cutting. Unfortunately, however, complete release from root competition is more than likely to result in openings that are too large. On the other hand, the shade prevailing in the immediate influence of Douglas fir, white fir, and some shrubs may be too dense. Much lighter shade is cast by the pines, oak, and aspen. Whether due primarily to differences in insolation, in the type of root system, or in the character of the leaf litter, it is an indisputable fact that in nature Douglas fir reproduces better under the pines, oak, and aspen than under the heavier Douglas fir and white fir. Not only do more seedlings become established under the first type of cover, but they grow faster and have a distinctly more thrifty appearance. Obviously, then, the occurrence of the pines, oak, and aspen in Douglas fir stands is to be encouraged.

On old burns grown up to oak and aspen, Douglas fir reproduction is usually good even though the number of seed trees is far less than on unburned cut-over areas. This being true, it would seem that a silvicultural system of clear cutting, with seed trees, followed by broadcast burning would be effective. The main objection to the method is that it destroys young trees which if preserved would form the nucleus of the future stand. Nevertheless, it may prove practical under certain conditions, particularly in dense, mature stands having little advance reproduction. The method at least deserves an experimental trial.

Conceivably, comparable results would be accomplished by the opposite extreme of light selection cutting. But here the crown canopy is formed by the uncut stand, and this is likely to be too dense

for Douglas fir. By piling and burning the slash, the larger openings would presumably be placed in good condition to restock. Essentially such conditions have been produced on localized areas in standard Forest Service cutting. But, although some seedlings usually start, they are seldom numerous and they make very slow growth. The method therefore is adapted only to stands in which the immature and young age classes are so well represented that relatively little reproduction is required. Since it has the important advantage of preserving young growth and maintaining forest conditions, it probably will become the most suitable method after the first or second cutting cycles, assuming that the present overmature stands can be rejuvenated.

Few of the present commercial stands are sufficiently uniform to lend themselves in large units to either of the two methods. Mature groups or small areas might occasionally be clear cut and the slash burned in a manner compatible with safety and silvicultural objectives. But groups of young age classes would call for selection cutting. No specific rules can be laid down. Each area should be cut according to its condition as determined primarily by distribution of age classes and presence or absence of advance reproduction.

TIMBER STAND IMPROVEMENT WORK IN THE BLACK HILLS

By THEODORE KRUEGER

Black Hills National Forest

CUTTING of timber in the Black Hills region started sixty years ago, when the pioneer sawmill was established in the town of Deadwood in 1876 by E. G. Dudley. Since that time much of the original stand has been opened up to various degrees through timber cutting, fires, and the Black Hills bark beetle. Cutting was especially severe in the northern part of the region during the early days, when large areas were deforested in connection with mining operations. In 1892 the botanist Rydberg wrote: "Sawmills are scattered all over the Hills, and it will be no wonder if in a short time the dark pine forest is gone and the name 'Black Hills' has become meaningless."

However, due to favorable climatic and soil conditions, with seed crops in favorable years, reproduction has been very heavy. Dense stands of reproduction, saplings, and poles now occur throughout the region on cut-over areas, old burns, and as an understory beneath mature timber. The height of these stands varies greatly, and all three classes may be encountered in a very short distance, or two or more may be found on the same site. Often the stands are so dense that growth is checked. These stands generally contain a gradation from fully developed, thrifty trees to gradually weaker, less thrifty, and finally dying and dead individuals.

History of Thinning in the Black Hills

The first thinning in the Black Hills was done in 1926, when an area near the Crook Mountain Ranger Station, consisting of a dense stand of ponderosa pine ranging in size from 4 to 8 inches d.b.h. and in age from 18 to 30 years, was set aside for use by farmers. Annual growth rings on the stumps showed that the trees were growing fast until 1916, when growth abruptly slowed down, due to crowding. In this area all of the trees to be cut were marked, but the farmers had little use for the smaller-sized material, and the cutting became a light thinning of overtopped trees, leaving the dominant and suppressed.

In 1931, desiring to have some representative plots, the Supervisors of both the Black Hills and the Harney National Forests established thinning plots, with ranger labor, in stands 40 years old, with trees averaging 25 feet in height and from 1 inch to 6 inches in diameter. These plots were thinned as shown in Table 1.

Table 1

THINNINGS ON BLACK HILLS AND HARNEY PLOTS

	Number of trees per acre Black Hills	Harney
Before thinning	2,598	2,035
Cut in thinning	2,122	1,500
After thinning	476	535

Using this work as an example, in 1931 the Homestake Mining Company of Lead, S. Dak., was interested in doing some thinning near its sawmill at Nemo. This company had a few employees for whom they did not have regular work, and under an administrative-use agreement these men were used to thin a small area near Nemo. The purposes of this work were to provide better fire protection for the company investment at Nemo by thinning the surrounding stands, and to employ labor. In this work on National Forest land a Forest officer marked or designated all trees to be left, and the

brush was piled and burned currently. Selection of the thinning area and decision as to the severity of thinning were left entirely to the local Forest officers.

Next, former Congressman William Williamson introduced a bill in Congress to provide $150,000 for the Black Hills and Harney Forests, to be used for thinnings as a matter of unemployment relief. However, this bill did not pass.

Still desiring to do at least what was possible under the circumstances, in 1932 we laid out thinning strips in an area near Deadwood accessible to a farming region. Free permits were given to farmers in exchange for cutting all trees which were to be removed. Each strip was labeled with the name and address of the permittee, and definite responsibility was fixed for the work on each strip. All trees to be left were marked, at first with a spot of paint, but subsequently with a bark blazer, since this was found to be faster and more convenient than a paint spot. All brush was required to be lopped and scattered.

In addition to this farmer thinning, Lawrence County needed firewood for relief purposes, and some crews of prisoners from the county jail were used. The prisoners were allowed two days of their sentence for every day they did thinning in the woods.

This preliminary work, while it did not cover a large acreage, did give us a basis for doing large-scale thinning operations when N.I.R.A. and E.C.W. funds became available in 1933. While our present methods of thinning are somewhat modified from the earlier work, they are essentially based on what was done before even the most optimistic of us hoped to have funds available for large-scale work.

Execution of the Work

Since the inauguration of N.I.R.A. and E.C.W. in May, 1933, 179,000 acres have been thinned on the Harney and the Black Hills National Forests to date (March 1, 1936), but an additional acreage of 125,000 acres is in need of thinning. The work done has also had an educational influence, and an increasing number of local people are beginning to realize the potential value of the young stands of timber if properly handled.

Kinds of Areas Being Thinned.—The areas in which thinning operations are carried on consist of dense stands of ponderosa pine from 5 feet to 30 feet in height and up to an average of 5½ to 6 inches in diameter, containing from 2,500 to 10,000 trees and more to the acre. However, the larger part of the work is in stands averaging 3,500 trees to the acre, with an average diameter of 3 to 4 inches and trees 14 to 25 feet in height.

Established logging units are used as thinning units, and at present all work is done by C.C.C. labor.

Selection of Trees to Be Cut.—Since the start of C.C.C. thinning, the selection of trees to be left has been made by the enrollees themselves; that is, no marking of trees with paint spots, bark blazer, or by other means is done. We found that, with proper training on the job, the average enrollee can be taught to select the trees to be left as well as or better than if they were marked ahead of thinning.

Enrollees are taught to look ahead for the trees to be left, the trees with the best crown development and good bole, as the aim is to retain so far as possible only trees with normal crowns and good trunks, which when freed will have room for free development of crown, but without making a permanent opening. The tree that has the greatest leaf surface and is exposed to light on all sides after thinning will ordinarily make the best growth, and this end is secured by cutting out the trees that are found to be interfering with the development of the favored trees. The aim is to give to the best trees the amount

of light and growing space most favorable for their best development. With increasing age, each tree in the stand demands more room both for crown and roots, which results in excessive competition for light and moisture in unthinned stands.

Ordinarily the dominant trees are selected for leaving, but not all dominant trees have both a good crown and a good bole. Often they have an abnormal crown development, fire scars, porcupine scars, *Peridermium harknessii*, or other defects. It is then necessary to cut the dominant and leave the best codominant tree.

Aspen is cut only if its cutting will release pines which are overtopped. Snags 20 feet or more in height are cut if located on exposed ridges or if they stand out prominently at long intervals in a stand of green trees.

Spacing of Trees Left.—While the correct method of thinning would be to start early in the life of the tree, and then come back at definite intervals of years and take more out, conditions are not such that we can install such an intensive system at this time, and we must accept a heavier thinning done at one time.

The number of trees to be left varies according to their height. Our instructions provide for the following standards:

1. Where the height of the trees in the stand that will be left after thinning averages from approximately 2 feet to 8 feet, the average spacing of the trees left is approximately 6 × 6 feet (1,200 per acre). An exception is made in the case of stands on rocky ridges where the soil is thin. On such sites no thinning takes place. Stands in which the trees left after thinning would average 2 feet or less in height are not ordinarily thinned. There are comparatively few areas being thinned in the Black Hills region where the trees are shorter than 6 feet in height.

2. Where the height of the trees in the stand that will be left after thinning is more than 8 feet but less than 15 feet, the average spacing of the trees left is approximately 8 × 8 feet (680 per acre). An exception is made in the case of spindling trees found under an overstory of large timber or in very dense stands. Where the trees to be left are spindling, the average spacing is reduced to 6 × 6 feet (1,200 per acre), 2 feet closer than the spacing ordinarily followed in stands of the height indicated.

3. Where the height of the trees in the stand that will be left after thinning is more than 15 feet but less than 30 feet, the average spacing of the trees left is ordinarily approximately 9½ × 9½ feet (480 per acre). An exception is made in thinning crowded stands when the trees left have narrow crowns. The average spacing in such stands is reduced to about 8½ × 8½ feet (600 per acre).

During the past year we have slightly reduced the above spacing, and at this time we endeavor to have from 5 to 10 per cent more trees left than the above standard.

One-tenth acre sample plots are established each day by foremen to serve as check plots in obtaining the proper number of trees per acre. The center or one of the corner stakes of each plot shows the plot number, the date established, the initials of the foreman, and the number of trees in the plot by height class, and total percentage.

From Table 2 it is simple to figure how close to standard the plot is. For example, if there are 10 trees on the plot which fall in the 6 × 6 spacing class, 24 in the 8 × 8, and 30 in the 9½ × 9½ spacing, the table would show the plot as 105.6 per cent of standard, thus:

Number of trees	Spacing class	Per cent of standard
10	6 × 6	8.3
24	8 × 8	35.2
30	9½ × 9½	62.1
		105.6

This table makes it possible to determine quickly how near to a normal average stand is the number of trees left, when two or more height classes are involved.

Insects and Disease.—All trees containing active broods of Black Hills beetles are cut. Our experience on the Black Hills Forest has been that by confining thinning to the period from about October 1 to April 15 we have had no difficulty with the engraver beetle (ips), and thinning has proved to be ideal for winter C.C.C. work in the region.

Trees 8 inches and less in diameter with active western gall rust (*Peridermium harknessii*) on the main stem are cut except where they are needed to provide the average spacing. Where possible, individual branches with *Peridermium* are cut off by the foreman.

Tools Used.—Few trees over 6 inches d.b.h. are cut, and the tools used are a brush hook, which works well for stands of trees up to 2 inches in diameter, and a 3½-pound double-bit axe for stands of larger trees.

For a small amount of pruning done, we have found a Fanno type curved-blade saw with coarse teeth the best tool. Handles for these saws are up to 12 feet long.

Table 2

Percentage of 0.1 acre occupied by given numbers of trees, with each spacing

Number of trees	Spacing 6′x 6′	8′x 8′	9½′x9½′
2	1.6	2.9	4.1
4	3.3	5.9	8.3
6	4.9	8.8	12.4
8	6.6	11.7	16.6
10	8.3	14.7	20.7
12	9.9	17.6	24.8
14	11.6	20.6	29.0
16	13.2	23.5	33.1
18	14.9	26.4	37.3
20	16.5	29.3	41.4
22	18.2	32.3	45.6
24	19.8	35.2	49.7
26	21.5	38.2	53.9
28	23.1	41.1	58.0
30	24.8	44.1	62.1
32	26.4	47.0	66.3
34	28.1	49.9	70.4
36	29.7	52.9	74.6
38	31.4	55.8	78.7
40	35.5	58.8	82.9
42	34.7	61.7	87.0
44	36.4	64.6	91.1
46	38.0	67.6	95.3
48	39.7	70.5	99.4

Field Organization.—Our thinning crews consist of from 25 to 35 men under one foreman, with men spaced 30 to 50 feet apart. The working day for C.C.C. labor is from 6 to 7 hours, depending on the distance of the work from camp.

Brush Disposal.—Trees are left as they fall, except occasional larger heavy-limbed trees, which are lopped off.

On main roads all brush resulting from thinnings within sight of the road is burned. On side roads the brush is burned for a strip 25 feet on each side of the road. In addition, a 6-foot fire lane is left open every 250 to 300 feet in dense areas, and on prominent ridges 50-foot-wide fire breaks are established by burning the brush.

Thus there is a system of fire breaks through the entire thinning areas.

Use of Material Cut.—In our present thinnings we are not looking for cash receipts from the trees cut, but rather are working for an increase in the value of the trees that are left. A practically treeless territory surrounds the Black Hills region, and free use of thinned material is granted to settlers, miners, and needy residents for firewood. This has been of great benefit during the past few years.

Cost of Work.—The cost of thinning any individual area depends on the size of the trees to be cut, the number per acre, and the condition of the ground. However, the average under all conditions for the 179,000 acres which have to date been thinned on the Black Hills and Harney National Forests is 3 man-days per acre, which includes the cost of necessary simple work-roads to the thinning areas.

SNOW DAMAGE IN PLANTATIONS

By JAMES D. CURTIS

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THE subject of snow damage in plantations is often misconstrued as being either too abstract to warrant attention or else of such mild and infrequent occurrences that it is inconsequential. Recent investigations carried out on the Black Brook plantations of the Harvard Forest reveal that snow damage is apparently something definitely tangible and that it can be checked, perhaps eliminated, in any plantation where snowfall reaches formidable proportions.

Snow damage, unlike ice breakage, can be expected to occur any or every year. The inability to forecast ice storms and to prepare for the havoc which accompanies them is everyday knowledge. Over much of New England, however, where snowfall is an annual event and where it can be expected to attain considerable depth, the question of snow damage in plantations assumes aspects of importance. If allowed to continue year after year without stand treatment, damage by snow is liable to assume alarming proportions. The forester should be prepared for extremes in weather, and he bears the onus of conducting his work accordingly. As there are many thousands of acres in plantations and many more in woodland under silvicultural management throughout the country, the results given below should be of interest to those who are included in the region of heavy snows.

Characteristic snow-damaged trees are found leaning in varying degrees of inclination from the vertical, and in extreme cases are found on the ground. Trees which do not regain their natural growing position and which are strong enough to resist more snow will continue to grow after being damaged. Since snow damage appears to be most prevalent in young stands up to 25 years of age, actual breakage of stem or branches is rarely found.

The Black Brook plantations, located at Hamilton, Mass., about 25 miles north of Boston, cover 106 acres, separated into five blocks on land of medium and poor sites. The topography varies from lowland to high and prominent gravelly ridges, although the greatest extent is on well protected and comparatively level ground. There is a total of 37 species of hardwoods and conifers, which occur in mixed, pure, even-aged and uneven-aged stands. The majority of the species, however, are to be found in pure even-aged stands, and all damage with few exceptions was confined to this type. Ages vary from 25 to 35 years and spacings from 3 feet and less to 6 feet.

Trees chosen for measurement were selected only if there was every reason to believe that snow had been the factor responsible for their disarrangement. This meant that trees only slightly leaning, which had been forced from the vertical by close spacing or by some rapidly growing individual which had seeded in and was causing them to adopt unnatural positions, were disregarded. The heavy snowfall of 1933-34, when the study was conducted, provided material for study of recovery and allowed better interpretation of damage from previous snowfalls. No sample plot method was adopted, but all damaged trees that could be located were recorded as they were found in the different blocks. Upon examination of numerous sectioned stems it was found that the damage had occurred over a number of years, including the current year of inspection. Furthermore, no case

of breakage was found, which is the most common feature of ice storm damage. This would eliminate ice as a major factor in deforming the trees recorded, since ice storms of consequence do not occur annually.

Measurements taken included diameter breast-high, height, maximum crown width (in the case of one-sided trees this amounted to slightly more than the ordinary width of a normal crown), crown length, nature of crown (whether one-sided or normal), the species, the angle lean, and the direction lean.

Results of data collected show that many species had been affected from year to year. The species and the number of each recorded is shown in Table 1.

The fact that 22 coniferous species are represented in the plantations and that 10, or 45 per cent of them, were affected by snow shows that many conifers are subject to this type of damage.

Additional species of conifers in the plantations, not damaged by snow, included:

TABLE 1

SPECIES AND NUMBER OF TREES SHOWING SNOW DAMAGE

Species	Number
Douglas fir—*Pseudotsuga taxifolia* (La Marck) Britton[1]	92
Norway pine—*Pinus resinosa* Solander[1]	9
Colorado blue spruce—*Picea pungens* Engelmann[1]	8
Scots pine—*Pinus sylvestris* L.[1]	4
Pitch pine—*Pinus rigida* Miller[1]	4
Northern white pine—*Pinus strobus* Linnaeus[1]	3
Jack pine—*Pinus banksiana* Lambert[1]	2
Austrian pine—*Pinus nigra* Arnold[2]	1
Norway spruce—*Picea abies* Karst.[2]	1
Red cedar—*Juniperus virginiana* Linnaeus[1]	1
Total (10 species)	125

[1]Specific names from Check List of the Forest Trees of the United States, by George B. Sudworth, U. S. Dept. of Agric., Misc. Circ. 92.

[2]Specific names from Manual of the Cultivated Trees and Shrubs Hardy in North America, by Alfred Rehder.

Western white pine—*Pinus monticola,* D. Don.

Western yellow pine—*Pinus ponderosa* (Lawson).

Black Spruce—*Picea mariana* (Miller) Britton.

Red spruce—*Picea rubra,* Hink.

White spruce—*Picea glauca* (Moench) Voss.

Engelmann spruce—*Picea engelmanni.*

Sitka spruce—*Picea sitchensis* (Bongard) Carriere.

Fraser fir—*Abies fraseri* (Pursh.) Poiret.

White fir—*Abies concolor* Lindley and Gordon.

Nordmann fir—*Abies Nordmanniana* Spach.[1]

European larch—*Larix decidua* Mill.[1]

Japanese larch—*Larix Kaempferi* Sarg.[1]

It was soon noted that many of the trees which had been thrown by snow had crowns on one side, or half of their circumference, only. This had been caused by the trees growing on the margins of stands or openings, or being suppressed from one side in close spacings. The number of trees which had been snow-thrown and which had one-sided crowns, as compared with trees which had normal crowns for the different species, is shown in Table 2.

With the exception of the Austrian and Scots pine, all cases examined show that trees with one-sided crowns are those most commonly thrown by snow. This can be easily appreciated when one considers a tree's leaf surface in proportion to its height and its inability to resist falling when the force of snow on half this surface is concentrated on one side.

Substantiating the above contention and the figures in Table 2 are the data set forth in Table 3, indicating the percentage of trees of each species which fell or inclined in the direction of their one-sided crowns.

[1]These names from Rehder's Manual; all others from Sudworth's Check List.

The figures in Table 3 further corroborate the evidence that trees most commonly thrown by snow are those with one-sided crowns. The percentages as afforded by the Douglas fir, which were planted most extensively in the plantations, are to be given more weight than the other species, which occur only sparingly in the examinations.

The action of snow on one-sided trees is evidently as shown in Figure 1. It can be easily understood that, once a tree is forced from the vertical, it is difficult for it to regain its former position. This is accentuated when subsequent snow falls and bends the tree nearer to the ground, at the same time disturbing the root system beyond recovery and often breaking the stem.

In the case where the tree is comparatively large and strong-stemmed, the action of snow ceases at stage "b," when the tree continues upward but with a marked and enlarged bow in the stem. If this bow is pronounced, its shape will persist for many years, ultimately making the tree difficult and expensive to saw for lumber, and useless for a pole.

Due to the fact that Douglas fir was the most commonly recorded species, an effort was made to determine further factors and their results, in connection with the damage.

In Figure 2 is shown the relation between the frequency of one-sided snow-damaged trees and d.b.h., by half-inch classes. As seen from the curve, the greatest number of trees damaged is between

TABLE 2

NUMBER OF DAMAGED TREES OF DIFFERENT SPECIES, WITH TYPES OF CROWN

Species	Percentage of trees with one-sided crowns	Total number of trees recorded
Douglas fir	80.5	92
Norway pine	88.8	9
Colorado blue spruce	87.5	8
Scots pine	50.0	4
Pitch pine	100.0	4
Northern white pine	100.0	3
Jack pine	100.0	2
Austrian pine	0.0	1
Northern white pine	100.0	3
Red cedar	100.0	1
Total	81.6	125

TABLE 3

DIRECTION OF FALL OF SNOW-DAMAGED TREES, BY SPECIES

Species	In crown direction	Trees recorded
	Per cent	Number
Douglas fir	78.2	92
Norway pine	88.8	9
Colorado blue spruce	87.4	8
Scots pine	50.0	4
Pitch pine	100.0	4
Northern white pine	100.0	3
Jack pine	100.0	2
Austrian pine	0.0	1
Norway spruce	100.0	1
Red cedar	100.0	1
Total	80	125

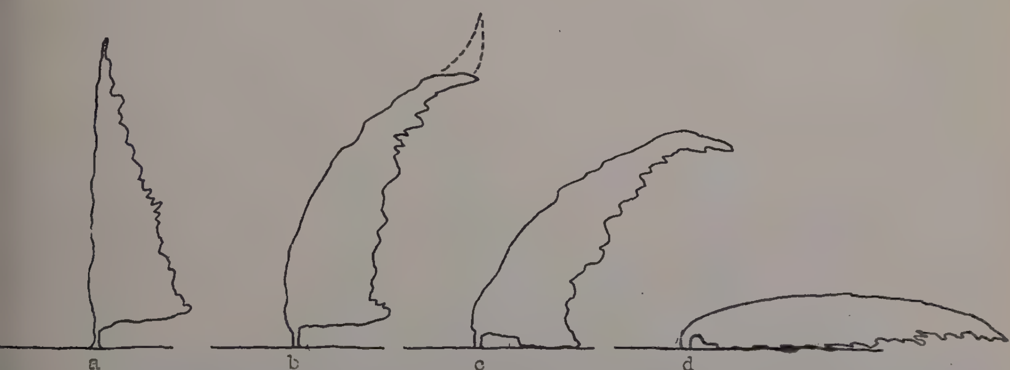

Fig. 1.—Showing the early action of snow on a vertical, one-sided-crowned tree, and the subsequent effect of more snow.

the diameter limits of 1.25 and 3.0 inches. These are largely trees in the codominant and intermediate crown classes, which, being weaker-stemmed and with crowns confined to the higher parts of the stem than dominants, can offer less resistance. It is significant to note the small number of trees occurring in both the low and high range of diameters, that is, in the suppressed and dominant crown classes. The former have a very small leaf surface and are shielded, while the latter have sufficient strength in their boles to resist the strain of snow load.

Figure 3 shows the relation of frequency of occurrence of one-sided trees to crown width for two spacings, and for both combined. It must be borne in mind, however, that the values for crown width are for one-sided trees only, and are therefore less than those of normally developed crowns. Since leaf surface is roughly proportional to crown width, it is possible to gain some idea of the effect spacing has on snow damage. It will be noted that in the lowest curve, for wide spacing, values of frequency for any crown width are substantially lower than the corresponding values for close spacing. This is what might be expected, since close-spaced trees tend to have smaller crowns, weaker stems, and greater opportunity for crown irregularities through the mortality of adjacent individuals, than wide-spaced trees with sufficient room for normal development. The average crown width for the one-inch diameter class was 2.47 feet, approximately the maximum point in the curve in Figure 3. It is interesting to note that the average d.b.h. of trees recorded in this diameter class was 1.60 inches, which falls within the high frequency of the curve in Figure 2.

In Table 4 is shown the number of trees, by species, which were found damaged in the different spacings. In this connection it is interesting to note that, regardless of species, snow damage is confined to the closer-spaced plantations of 3 x 3 feet and 4 x 4 feet, with relatively little damage taking place in the wider spacings of 5 x 5 feet and 6 x 6 feet.

General observations on natural unmanaged stands of white pine and hemlock have shown that the relations brought out in this study are analogous. In dense second-growth pine, where snow cannot filter through to the ground and becomes lodged on one-sided crowns, snow-throw is induced which ultimately results in so-called mass breakage. In pure hemlock stands, trees of the intermediate crown

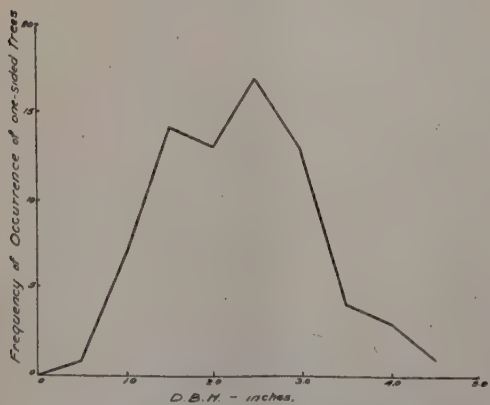

Fig. 2.—Showing the relation between diameter and frequency of one-sided, snow-damaged Douglas fir.

TABLE 4

TOTAL NUMBER OF SNOW-DAMAGED TREES, BY SPECIES, FOR DIFFERENT SPACINGS

Species	Spacing in feet 3x3	4x4	5x5	6x6
Douglas fir	50	35	5	2
Norway pine	2	4	–	3
Colorado blue spruce	6	2	–	–
Scots pine	–	–	–	4
Pitch pine	4	–	–	–
Northern white pine	2	1	–	–
Jack pine	2	–	–	–
Austrian pine	–	1	–	–
Norway spruce	–	1	–	–
Red cedar[1]	–	–	–	–
Total	66	44	5	9

[1]Single marginal tree in red pine plantation.

class and weak codominants have been observed seriously damaged after heavy snows.

The above values indicate that, although slight, there is a tendency for wider-crowned trees, whether one-sided or not, to be thrown nearer to the ground than trees of similar diameter and height with narrower crowns.

In one instance, 11 Douglas fir were found grounded in one group, creating a large opening in the stand. These trees averaged 3.85 inches in diameter and 28 feet in height. It was found upon examination that this mass fall had been induced by two one-sided key trees. These two had taken three others with them in their fall, and it was concluded by cross sectioning and ring count that the remaining ones had followed their neighbors into the recently created opening in subsequent years. It is not impossible that many cases of so-called mass breakage could be traced to a similar initial cause. Openings of this nature are highly objectionable in any stand, and are difficult to counteract when they have once gained headway.

Summary of Conclusions

The results of this study show that in plantations:

1. Douglas fir, Norway pine, Colorado

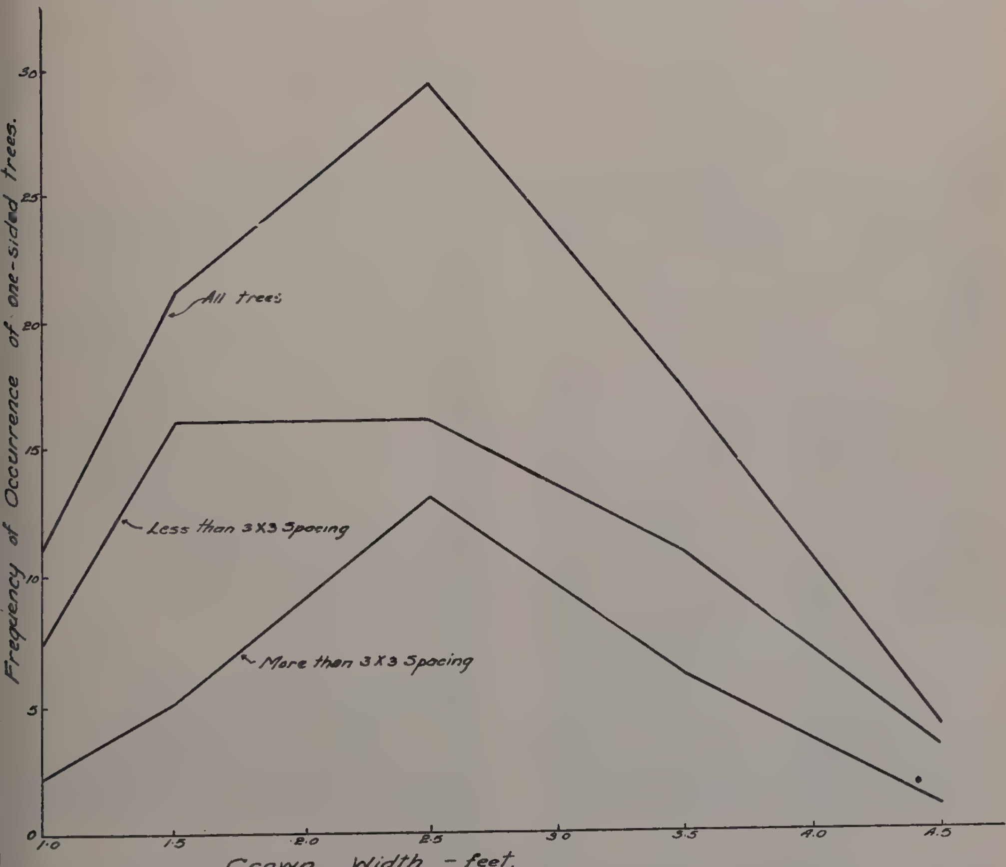

Fig. 3.—Relation between crown width and frequency for one-sided, snow-damaged Douglas fir for two different spacings, and for the two combined. Note the lower number of trees occurring in spacing greater than 3 x 3 feet.

blue spruce, Scots pine, pitch pine, Northern white pine, Jack pine, Austrian pine, Norway spruce, and red cedar are all subject to snow damage.

2. Trees with one-sided crowns are more liable to be thrown by snow than trees with normal, symmetrical crowns.

3. Eighty per cent of the trees included in the study fell or inclined to the side on which the crown was largest.

4. Damage to Douglas fir occurred commonly only among trees ranging in diameter from 1.5 to 3 inches and in height from 13 to 25 feet; trees in the intermediate and codominant crown classes.

5. Damage to Douglas fir was found to be maximum among trees of a crown width of 2.5 feet, corresponding to a d.b.h. of approximately 1.6 inches—trees of the intermediate crown class.

6. Snow damage was most prevalent in Douglas fir in spacing not exceeding 3 x 3 feet.

7. Trees found thrown by snow ranged from 0.95 inches in diameter and 9.5 feet high to 5.60 inches in diameter and 35 feet high.

8. One case of mass breakage, including 11 Douglas fir averaging 3.85 inches in diameter and 32 feet in height, was traced to two one-sided trees which preceded the other 9 in their fall.

It would appear that snow damage in plantations could be greatly offset and possibly eliminated by judicious thinning to prevent the formation of unsymmetrical crowns on conifers. This would mean that trees of this description should be removed in thinnings, if possible, but that large openings should not be made, since they induce a crown formation which fa-

Fig. 4.—Three snow-damaged Douglas fir along the margin of a road. These trees were strong-stemmed and able to keep from falling to the ground. In all three cases vertical height growth of the leaders has been resumed.

Fig. 5.—A typical one-sided tree (Douglas fir) which was growing on the margin of a road. Tree leaning to the side on which the crown is growing.

vors snow-throw. Consequently, from the snow damage standpoint, heavy thinnings should not be made. If possible, thinnings should be carried out when the season of heavy snowfall is over, so that when the support afforded by trees to be thinned has been withdrawn, the remaining trees will have an opportunity to become strong-stemmed during the ensuing growing season. In cases where one-sided trees are situated along the margins of stands or openings, or where openings have unavoidably been created, pruning, drastic if necessary, could be carried out to better balance the crown and lessen the danger from snow. Although pruning in such cases would be a highly intensive practice, it would diminish damage, or possibly prevent it if there was no snow breakage already, and save the stand in question from further devaluation. In instances where openings occur in young plantations, care should be taken to offset the possibility of snow damage by filling in with additional stock. In relation to spacing, the results from this study show that plantations spaced 4 x 4 feet or closer are subject to considerable damage by snow, regardless of species. In plantations of wider spacing, however, stands should be treated in such a way that trees are not allowed to become one-sided, especially when young, as such conditions are favorable to snow-throw.

The number of trees, all species included, which were found inclined less than 45 degrees from the vertical corresponded very closely to that for trees inclined more than 45 degrees. This evidently means that crown width has little influence on the angle of lean, and that, all things considered, subsequent snowfall after the trees have been initially bent contributes most to the final position. On examination of the Douglas fir, however, it was found that the average crown width of all one-sided trees which were inclined at less than 45 degrees was less than the average for crowns of trees which were leaning at greater angles. This was also true for trees whose crowns were to all intent symmetrical. This relation is set forth in Table 5.

TABLE 5

AVERAGE CROWN WIDTHS FOR TREES WITH DIFFERENT ANGLES OF LEAN

Angle of inclination	Less than 45 degrees		More than 45 degrees	
Crown	One-sided	Normal	One-sided	Normal
Average crown width, feet	3.12	4.27	3.24	4.91
Number of trees	47	13	55	11

THE EFFECTIVENESS OF PARTIAL BARK PEELING IN THE CONTROL OF IPS

By E. M. HORNIBROOK

Rocky Mountain Forest and Range Experiment Station

THE engraver beetles, members of the genus *Ips*, are usually found throughout the range of ponderosa pine (*Pinus ponderosa* Lawson). Four species, *Ips lecontei* (Sw.),[1] *I. integer* (Eichh), *I. oregoni* (Eichh), and *I. ponderosae* (Sw.), have previously been reported as commonly occurring in Arizona and New Mexico. In general they are found in endemic numbers and act as scavengers, breeding in logging slash, cull logs, and mechanically injured, lightning-struck, and windfallen trees. They seldom become abundant enough to threaten seriously vigorous living stands excepting in the case of improvement cuttings or logging operations that are suddenly curtailed, leaving insufficient slash for the increased population to enter.

The C.C.C. and N.I.R.A. timber-stand improvement operations in pole stands of ponderosa pine throughout the Southwestern Region have necessitated the cutting of many trees. In order to guard against building up an *Ips* population of epidemic proportions the Regional instructions governing timber-stand improvement procedure call for partial peeling of all poles 4 inches and over in diameter cut during the summer months, leaving strips of bark not exceeding 3 inches in width. It was anticipated that the bark strips would serve as traps; that the emerging new adults would attack the poles, make their galleries in the strips, and lay eggs as in the normal development of a new generation; and that the subsequent drying of these narrow bark strips would result in a high mortality of the larvae and pupae. In actual practice the bark strips are often left wider than 3 inches; in some cases only the top and sides of poles are peeled, leaving the bottom side untouched.

The purpose of this study was to determine the effectiveness of various degrees of peeling in preventing an increased *Ips* population.

In order to obtain some information on the question, a simple experiment was started June 1, 1935, in the Fort Valley Experimental Forest near Flagstaff, Ariz. The experimental area has a southerly exposure and lies at an altitude of 7,360 feet. Due to the urgency of other projects, very little time was available for this study and consequently its scope was limited. However, the results obtained should indicate what may be expected under similar conditions.

METHOD

Twenty-five logs 4 feet long and varying from 4 inches to 8 inches in diameter at the top end were cut from blackjack poles felled in improvement operations. These logs were randomly divided into five groups of five logs each. To each group was given one of the following five treatments:

1. Partial peeling, leaving bark strips 2 inches wide.
2. Partial peeling, leaving bark strips 3 inches wide.
3. Partial peeling, leaving bark strips 4 inches wide.

[1]This species in Arizona was formerly described as *Ips confusus* (Lec.).

4. Partial peeling, leaving bark strips 5 inches wide.

5. Control. No bark removed.

Care was exercised in peeling in order to leave each strip exactly the width called for by the treatment. These groups of logs were placed in small openings in the stand, to simulate conditions under which cut poles are usually disposed. In general, they received morning sunshine and afternoon shade, although this was reversed in some cases. This treatment provided free access for natural enemies and natural controlling agencies. One end of each log was elevated by being placed on a pole 6 to 8 inches in diameter, and the other was left in contact with the forest floor. The experiment was laid out in the center of an area that had undergone stand improvement operations the same day. Therefore, additional freshly cut and partially peeled poles were near at hand, on which observations were made from time to time to determine the progress of the broods.

At the time the experiment was started a new generation of *Ips integer* (Eichh) and *I. oregoni* (Eichh)[2] was emerging on an adjacent area of older cutting. An attack was started on the logs within 24 hours, and within 1 week it was rather heavy on all logs excepting those with the 2-inch bark strips. This was a fortunate condition, as it contributed toward a uniform development of the broods. Another factor counteracting the variation of maturity dates and contributing toward an accurate count of emerging *Ips* is the fact that new adults usually remain in or under the bark for nearly 5 days after attaining adulthood.

The first maturing adult was observed July 29, 59 days after the experiment was started. A close watch was maintained until August 4, or 65 days after the first attack. It was then determined that most of the pupae had become adults and that further delay in making counts would result in complete emergence and the escape of some of the brood. Had funds and time been available, each group of logs would have been enclosed in a fine mesh screen cage and counts of the emerged and trapped adults made. Since this was not possible, the bark on each log was carefully shaved with a draw knife and counts made on only the living new adults. The occasional pupae that were found were not included in the count. The bark was completely removed from each log and the number of attacks determined by a count of the nuptial chambers. Care was also taken to ascertain if position of the bark strips with reference to the top, sides, bottom, or elevated or grounded end of the logs had any noticeable effect upon the number of maturing adults.

Results

Table 1 gives a comparison of the results obtained under the five treatments. Those obtained from the 2-inch bark strips are striking in that there were no adults. The interesting thing about this treatment is that 10 of the 15 attacks were abandoned after galleries 2 to 4 inches in length had been constructed. The galleries from the other five attacks were 6 to 9 inches long, which is shorter than usual, and in each case the larvae dried up and died before attaining the pupal stage.

It is notable that there is a difference of only one in the number of attacks between the 3- and 4-inch bark strips. However, the total number of new adults developed in the 4-inch strips is slightly more than 2½ times that in the 3-inch strips. It is easily seen that as the width of bark strip increases the number of new adults increases rapidly.

[2]Identification was made by Dr. M. W. Blackman of the Bureau of Entomology.

Keen[3] reports one male and several females per attack, and Vincent[4] reports one male and one to three females per attack. From Table 1 the results of this study show that on the average 4.6 new adults per attack matured in the 3-inch bark strips. The number of adults maturing in the 3-inch bark strips seems to be but slightly greater than the original number of beetles entering these strips, according to the reports by Keen and Vincent. The foregoing indicates that the partial peeling of poles leaving the bark in 3-inch strips is sufficient control to prevent a resident *Ips* population from greatly increasing its numbers.

Observations of interest, not disclosed in Table 1, are as follows:

1. In all cases of partial peeling, the end of the log in contact with the ground was obviously more moist than the elevated end. This difference was not noticeable in the logs on which no bark had been removed.

2. On the 2-inch strips, most of the abandoned attacks were on the tops and sides of the logs, where drying out of the bark took place most readily. The galleries containing larvae were on the under side of the log and in most cases near the grounded end.

3. In the case of the 3-inch treatment the greatest mortality of larvae and pupae occurred on the top and side strips. This appeared to be the result of the bark drying from the edges toward the center. The majority of the new adults were found on the under side of the logs and on the sides near the grounded end.

4. Drying of the bark strips on the 4- and 5-inch treatments was noticeably less than on the 3-inch treatment, and a lower mortality of larvae and pupae ensued.

TABLE 1

COMPARISON OF THE NUMBER OF NEW ADULT *ips* MATURING IN FOUR DIFFERENT WIDTHS OF BARK STRIPS AND ONE CONTROL

Number of 4-foot logs	Width of bark strip in inches	Total number of attacks	Total number of new adults	Percentage of new adults using the control as 100	Average number of new adults, per attack
5	2	15	0	0.00	0.0
5	3	45	207	17.28	4.6
5	4	46	530	44.24	11.5
5	5	54	684	57.01	12.7
5	Control; no bark removed	88	1198	100.00	13.6

[3]Keen, F. P. Insect enemies of California pines and their control. State of Calif. Dept. of Natural Resources, Div. of For., Bull. No. 7. 1929. Illus.

[4]Vincent, Paul Y. *Ips* (*tomicus*) *confusus* and the effect of stripping on pole stands after a thinning and improvement cutting in ponderosa pine. Unpublished report in the files of the Forest Service, Albuquerque, N. M.

BRIEFER ARTICLES AND NOTES

Austin Cary, 1865—1936

Death has suddenly taken one of our oldest, most distinguished, and most honored members. The Journal publishes in this issue, for the immediate information of the Society, the bare facts concerning the circumstances of his death, as related by Professor Newins, and brief biographical data. To this factual material it is suitable to add now a personal tribute of appreciation which constitutes the response of our President to the first announcement of Cary's passing. Later, there will be arranged a commemoration that will permit the Society more generally to give recognition to the loss it has suffered and to the unique contribution made by Cary to American forestry—a contribution that in itself, rightly evaluated, must stand as an enduring memorial to a remarkable personality.

Dr. Austin Cary, one of the foremost foresters of America, and a Fellow in the Society of American Foresters, died suddenly, Tuesday, April 28, at 10:40 a.m., on the campus of Florida University while about to keep an engagement with Professor Harold S. Newins, head of the Department of Forestry.

Dr. Cary had presented the Department of Forestry, on the day before, copies of his various publications, and was returning with two additional books, one of which was his "Woodsman's Manual," when, upon reaching the second floor hallway of the Agriculture Experiment Station Building, he collapsed against the wall, and died instantly.

The funeral services at Lake City, Florida, April 29, were attended by Dr. Cary's brother and nephew, many local foresters, and other intimate friends.

The body was cremated at Jacksonville April 30.

Dr. Cary, who was 71 years of age, will always be remembered in forestry circles for his quaint New England precepts and his rugged individual personality.

H. S. Newins.

Austin Cary was born in East Machias, Me., July 31, 1865. Following graduation from Bowdoin College with the degree of A.B. in 1877 he taught at Bowdoin for a year as instructor in the department of geology and biology, after which he pursued further studies in biology at Johns Hopkins and Princeton (1888-1891). In 1890 Bowdoin admitted him to the degree of A.M. From 1893 to 1896 he was in the employ of the Maine Forest Commission and the Forestry Division of the U. S. Department of Agriculture; and in 1898 he took a position with the Berlin Mills Company, as forester, which he held until 1904.

In the spring term of 1904 and 1905 he taught at the Yale School of Forestry. From 1905 to 1909 he was assistant professor of forestry at Harvard. In 1909 he published the first edition of his Woodsman's Manual. The same year, he was called to New York to serve as Superintendent of the State Forests. Ill health led to his resignation a year later, when he began his long period of work in the U. S. Forest Service.

H. A. Smith.

With so wide an acquaintance there will be many who may wish to add their word to the memorial of Austin Cary. My chief contact with him was in the spring of 1904, when he loaned his services to the Yale School of Forestry to instruct the senior class in topographic mapping at Milford, Pa. He gave to this subject a rugged vitality that characterized all of his professional activities; one never forgot what he taught.

Cary was the most absolutely sincere man I have ever known, in or out of forestry. He tested all facts by personal observation, and was constantly searching for evidence by study of the behavior of trees and forests on the ground. He was an inveterate note-taker, and though he apparently had no system of filing his data he could lay his hands on any item, no matter how far back it was. From his early association with the Brown Corportation, which gave him his standing as the oldest practicing forester in America, down through his long career with the U. S. Forest Service, begun under his pupil and friend William B. Greeley and ending with his retirement last year, Cary's method was that of individual research and contact. He was a free lance, and was given carte blanche by the Forest Service to do as he thought best. In the Pacific Northwest, and later in the South, he made extensive personal contacts with timbermen, talking over their problems in the woods and endeavoring to interest them in simple and practical measures of silviculture.

Unless his diaries reveal it, the extent of his influence in the South will probably never be known. Private operators, as long as taxing authorities are interested only in discovering new sources of revenue, of which growing timber is one, are not enthusiastic about admitting to the world that they are eliminating depletion by sustained yield practices. Yet many concrete instances occur where foresters have to their astonishment discovered firms that have been carrying on thinnings, waste disposal, and other measures for many years, which, when the facts were learned, traced back to some visit paid them by Austin Cary.

As an individualist Cary firmly believed in the efficiency of private industry as the solution of most of our problems of producing new forests. Being financially able to do so, he made many investments in second-growth timber, begining in Maine with white pine woodlots but later transferring his interest to southern pine. He was one of the investors in the second-growth operations of Mr. Alex Sessoms of Georgia, but sold his stock after the disastrous fire which occurred on that property.

Cary while employed by the Forest Service refrained from public criticism of any Service policies which seemed to him to run contrary to his basic philosophy. On his retirement, he felt it to be his duty to protest against the form which the acquisition policy took in his home state of Maine, and was apprehensive of the possible interference with private enterprise of the extensive purchase program in the South. He felt that it was his duty to bring this matter before the National Forest Reservation Commission. Such public effort, however, was foreign to his whole trend of activity, and although from a sense of duty he saw the thing through, he later expressed, with evident relief, the feeling that the proper emphasis having been given to this thought, he could leave it to others to carry on and could resume his customary methods of individual contact through conversations and personal public discussion of his findings.

Cary stood for sound common sense as applied to private forestry operations, and has left an indelible impression on American forest practice. There never was nor will be a man in the profession possessed of such marked individuality. Scores of anecdotes of his personal be-

havior serve to enliven fireside conversations wherever he is known. A pioneer in forestry has passed to the great beyond, and the world is richer for his former presence.

H. H. Chapman.

N. L. M. A. Continues Its Support of Public-Private Cooperation

The Directors of the National Lumber Manufacturers Association adopted at their annual meeting in Chicago April 23-25 resolutions on forest conservation which assure full continued participation of the industry in forwarding the joint program of the public and private agencies represented in the 1934 Forestry Conference. It will be recalled that this conference was convened by the Secretary of Agriculture at the request of the industries operating under the Lumber Code, to formulate a program for redeeming the obligations accepted by these industries with respect to conservation; and that to implement the program then formulated, a continuing joint committee was set up. As the resolutions make clear, the action taken at Chicago included provision by the N. L. M. A. for carrying the personnel requisite to further the work of the joint committee.

The resolutions adopted by the Association follow.

Resolutions on Forest Conservation

"Permanent lumber and other forest-using industries are essential to National welfare. We recognize the vital relation of forest conservation and renewal to the permanency of such industries and of their employment. We believe that in forest ownership, operation and renewal there should continue to be the fullest possible reliance, by the public, upon private enterprise and initiative.

"We believe that forest industries should accept the responsibility and obligation to cut and protect their forest lands so as to provide for regrowth.

"We accept the continuous production, or sustained yield, of forest resources as the ultimate objective of our industries. To hasten the attainment of this objective, we urge effective cooperation by state and federal agencies, including the enactment of needed legislation recommended by the Forestry Conference of 1934.

"We reaffirm our participation in the joint conservation program of public and industry action formulated by the National Forestry Conference.

"We regard the joint committee, composed of an equal number of industry representatives and public representatives, as an essential and effective agency for carrying forward the joint program, and we commend the work of this committee.

"We have made provision for the continuation of the National Lumber Manufacturers Association Forest Conservation Department and personnel, and we urge the constituent regional associations to continue and strengthen their participation in the joint conservation program, by:

"(1) Maintaining in each association a technical forestry staff to aid and encourage individual operators in applying sound forest practices and, wherever practicable, adopting selective logging methods and sustained yield management.

"(2) Cooperating with public agencies in accomplishing the public part of the program."

What Lies Ahead

Under the Lumber Code, 27,000 operators produced 100 per cent of the lumber and timber products of the country. Within the N.L.M.A. Federation are less than 1,000 operators, who now produce 61 per cent. These operators are organized in 14 regional associations, 11 of

which are concerned with primary conversion of forest resources. Four of these 11 associations maintain strong technical forestry staffs, which are engaged in extending by educational means the understanding of and compliance with forest practice rules evolved under the Lumber Code. These four associations produce approximately 75 per cent of the forest products put out by the entire Federation. Compliance with the forest practice rules is gaining ground steadily.

Of the other seven associations, two have technically trained foresters in charge, and two are in a formative state, so far unable to meet the budget requirements of technical staffs. The other three associations occupy regions where selective logging is the established method and where overcutting is not a serious menace so long as market conditions remain substantially as they are at present.

Meeting May 4, 1936, the joint committee examined industry progress and found it substantial, but was somewhat disturbed over continued failure to secure state and particularly federal legislation, calculated to promote continuity of forest ownership. It was the conclusion of the committee that it is highly desirable that the National Forest Conservation Conference be reconvened in the relatively near future.

It is, of course, apparent that a good deal of exploratory work must be done in advance, in order to assure participation of all substantially interested groups. During the next several months it will be the purpose of the joint committee to study, with representatives of industry and public agencies, the entire field of the possibilities. It will be recalled that the Conference did not definitely disband, but recessed, to be reconvened on recommendation of the joint committee upon the approval of the Secretary of Agriculture. While the legal basis for this Conference and its recommended program have gone the way of the N.R.A., the program has been found sound and applicable under present conditions. The need is felt to be not so much for a new or different program as for reaffirmation of the existing program, with possible improvements indicated by experience. And it is felt equally important to secure the approval of public and private agencies, via conference, for the mechanisms by which such a program can be carried forward.

John B. Woods,
Secy. to the Joint Committee.

The Proposed Mount Olympus National Park

A Bill known as the Wallgren Bill, which would convert the Mount Olympus National Monument into the Olympic National Park and would increase its size by transfer to the new Park of some 609 square miles from the surrounding Olympic National Forest, has been the subject of much heated debate and argument pro and con during the past winter and spring. The House Committee on Public Lands devoted over eight days toward the end of April and early in May to a series of hearings on the Bill, during which representatives of the National Park Service, the Forest Service, supporters of both these government bureaus, and representatives of local chambers of commerce interested in the industrial and economic welfare of the Olympic Peninsula all presented testimony. Practically the only organization interested in the principles involved which did not speak its piece at these hearings was the Society of American Foresters. Having no mandate either from the Council or from the electorate, the Executive Secretary simply played the part of an interested observer.

Out of the whole maze of testimony offered at these hearings it would appear that public opinion is pretty nearly unan-

imous on one point; namely, that in the mass of the Olympic Mountains, which occupy the heart of the great peninsula of the same name separating Puget Sound from the Pacific Ocean, there is an area of wild country so precious from the standpoint of its natural beauty and wonder that it must under some form of federal ownership or policy be preserved for all time from any form of economic development or commercial exploitation. From this point on, however, public opinion plainly begins to diverge along two lines.

First, there is by no means agreement as to the location of the boundaries of the area to be preserved. The boundaries as proposed in the Wallgren Bill are satisfactory to some. To others they do not take in enough territory, and to still others they take in altogether too much land carrying stands of commercial timber which in the years to come will be essential for the successful consummation of a carefully planned sustained-yield scheme of forest industry development and stability. Some argue that while the proposed boundaries take in too much timber on the west, they fail to include a desirable area of snow-capped mountain crags on the east.

The second divergence of opinion was on the question of the governmental bureau to which should be entrusted the custody of the area. Representatives of the Forest Service argued that the public interest would best be served, and much more economically, if the preserved area were handled as a part of the surrounding National Forest. Representatives of the National Park Service held that, since this was an area which must be preserved absolutely from all forms of commercial or economic use, it should obviously be called a National Park. The Forest Service, whose duty it is to conserve through wise use the lands under its jurisdiction, axiomatically, according to the Park advocates' point of view, should not be entrusted with a job of preserving from all use.

The proponents and supporters of the National Park Service of course upheld the views offered by that Service, and the supporters of the Forest Service upheld conflicting views. The representatives of other agencies took sides one way or the other. At the close of the hearings the Public Lands Committee decided to report the Bill out favorably, with certain minor changes in the boundaries. Whether a similar bill will be introduced in the Senate or whether that body will wait until the House has passed the measure and referred it to them remains to be seen. Whether this bill will be enacted during the present session of Congress or whether it is one of the innumerable pieces of proposed legislation which will be lost in the ruck and rush of the final days of the session cannot be foretold.

Much more important questions are involved than merely what shall be done about the Olympic Mountains. Far-reaching questions of policy and principle ought to be faced. If the fundamental problems are squarely met and successfully solved, the results should be of immense value. On the other hand, disposal of the matter without the most careful consideration and inquiry to reach a conclusion basically right rather than immediately expedient may do great harm, because of its weight as a precedent.

A resolution passed by the Board of Directors of The American Forestry Association at its quarterly meeting, which chanced to be held while the hearings on the Wallgren Bill were going on, pointed the way to a course of action well worth the careful attention of Congress. The resolution follows:

WHEREAS, this Board at its meeting on January 13, 1936, adopted the following resolution:

That the Board favors permanent preservation of a substantial body of the

finest primitive forest within the region of the present Mount Olympus National Monument without reference to the jurisdiction of the area, which resolution is hereby reaffirmed.

WHEREAS, the proposal of the Wallgren Bill (H. R. 7086), to establish a National Park in the Olympic Mountains, involving the transfer of a large area from the Olympic National Forest, has given rise to widespread difference of opinion as between departments of the government and among citizens and civic organizations interested in wide conservation, and

WHEREAS, these differences of opinion touch fundamental and far-reaching principles which underlie the selection of areas to be dedicated to National Park administration,

THEREFORE, BE IT RESOLVED, that the Directors of The American Forestry Association recommend:

(1) That action on the Wallgren Bill be deferred until a later session of Congress.

(2) That the Secretary of the Interior and Secretary of Agriculture be urged to appoint jointly a committee of disinterested experts, outside the government service, to make a thorough study of the problems and policies involved and to make recommendations that may enable the two Secretaries to unite in a common recommendation to Congress.

The Society of American Foresters embraces in its membership foresters employed in all the diversified fields of activity pertaining to the profession, and is interested as a professional body in seeing the right thing done, without *parti pris* and on the basis solely of what is in the best public interest. The present pulling and hauling, with one federal bureau pitted against another in a struggle to make its views prevail over opposing views through legislation and without a fundamental policy to govern both bureaus, is not in the best public interest. Of the total area of forest land which, it is commonly accepted, should remain permanently in federal ownership, some undoubtedly should for all time be preserved from all economic use. The rest (a much larger area) would be conserved for all time through wise use, including economic use. Just which form of custodianship best applies to a given area and gives best assurance of protecting the public interests involved is something, it is believed, which the forestry profession should play an active and constructive part in working out.

Repeatedly during the past several years the Society has been called upon to participate in movements or in legislative efforts in which these principles are involved, and it will undoubtedly be called to help with increasing frequency in the future. Possibly in discussing and interchanging amongst ourselves ideas and opinions pro and con the Olympic National Park we can help as a profession materially to clarify the general public point of view on the underlying general principles of federal ownership and managerial policy.

Franklin Reed.

Increment Determination on the Basis of Stand Tables

The September, 1935, issue of the Journal of Forestry contained an article (pages 799-806) by H. A. Meyer, entitled "A Simplified Increment Determination on the Basis of Stand Tables", on which the following comment is offered.

Meyer defines *double rising* as the sum of the number of trees rising in and out of a diameter class during the period, and from this he determines the mean. He also defines *double effective* as the sum of the number of trees in a diameter class at the first and second inventories, and from this he gets the mean number

TABLE 1

COMPARISON OF VALUES OF INCREMENT BY FORMULAS 1, 2, 3, AND 4

Diameter-class	(1) $\frac{\text{Rising out}}{\text{No. in class}}$	(2) $\frac{\text{Double rising}}{d_1 + d_2}$	(3) $\frac{\text{Double rising}}{d_{m1} + d_{m2}}$	(4) $\frac{\text{Double rising}}{\text{Double effective}}$
35	.133	.092	.074	.156
33	.083	.120	.103	.104
31	.154	.138	.092	.158
29	.130	.150	.102	.160
27	.157	.150	.113	.168
25	.147	.146	.117	.160
23	.146	.138	.116	.156
21	.134	.126	.117	.144
19	.122	.118	.118	.124
17	.116	.108	.113	.116
15	.104	.096	.105	.100
13	.091	.080	.089	.080
11	.068	.060	.068	.056
9	.052	.042	.046	.038
7	.028			

of trees contained in a diameter class during the period.

He then calculates mean annual diameter increment from the quotient:

$$\frac{\text{double rising}}{\text{double effective}}$$

by multiplying by the size of the diameter class and dividing by the period between the two inventories.

Now the number of trees rising out of a diameter class must depend upon the number of trees in that diameter class at the commencement of the period, and therefore diameter increment should be a function of:

$$(1)\quad \frac{\text{no. of trees rising out of a diameter class}}{\text{no. of trees in that diameter class}}$$

Or of:

$$(2)\quad \frac{\text{double rising}}{d_1 + d_2}$$

where d_1 and d_2 are the numbers of trees in a diameter class and in the next lower diameter class.

We might go one step further and consider that the mean number of trees in a diameter class would give a better approximation; if so, we could use the modified form:

$$(3)\quad \frac{\text{double rising}}{d_{m1} + d_{m2}}$$

where d_{m1} and d_{m2} are the mean numbers of trees in the diameter class and the next lower diameter class between the commencement and finish of the period.

Thus, including Meyer's figures, we have four sets of values for increments of various diameter classes, and it cannot be said which is nearest to the actual increments without exact measurements of individual trees at the two inventories.

Comparison of these four values of increment is given in Table 1.

Regarding the applicability of the method to the determination of the increments of the various diameter classes in a crop of uneven distribution, the following points should be considered.

(1) Perusal of Table 2 in Meyer's article shows that (a) in a general distribution the number of trees in a diameter class may be less than, equal to, or greater than the number of trees in the next upper or lower diameter class; (b) it is practically impossible for all trees of a diameter class to pass up into next higher diameter class in a reasonable period such as 10 years, and (c) the case of the number of trees in a diameter class AB equalling the number of trees in the next higher diameter class A′B′ is a very rare one.

(2) The assumption that the whole of

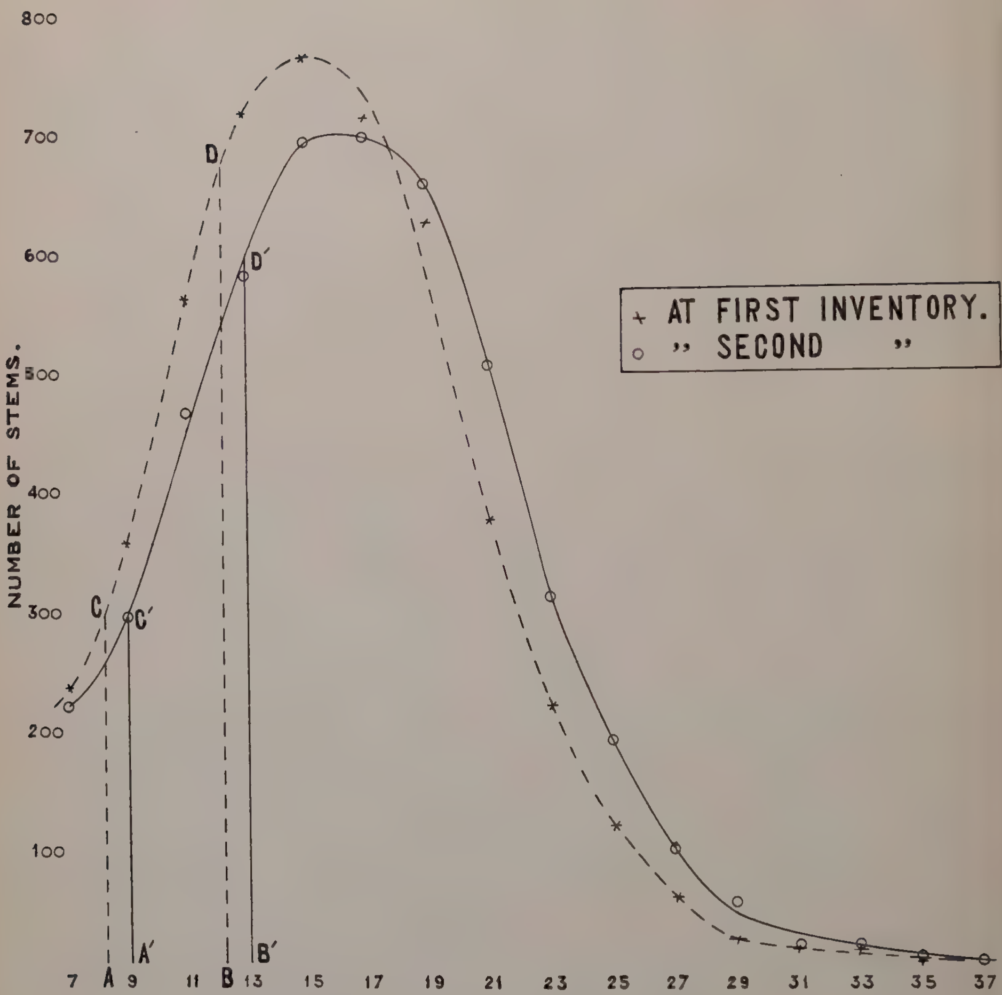

Fig. 1.—Plotted curve of data tabulated by Meyer.

the general distribution curve would be displaced i units to the right at the end of the period is also proved to be incorrect by Curve x (Figure 1), based on the data of Meyer's Table 2. All trees do not grow at the same rate, and the distribution curve is affected differently from section to section.

(3) An examination of Figure 2 shows that the equation:

$$i = \text{periodic diameter increment} = \frac{\text{double rising}}{\text{double effective}} \times a$$

is only derivable in the very limited case when (a) i is such that the ordinates through the new positions of A and B, viz A′C′ and B′D′, are equal to AC and BD and area ABDC=area A′B′D′C′; and (b) i (the shift) is equal to $\frac{1}{2}a$, the diameter class.

This means that the above equation would hold good when all the trees of diameter A pass up to diameter A′ and also all the trees of diameter A′ pass up to diameter (A′+½a), etc., i.e., when the

distribution is very even and growth strictly uniform.

It would therefore appear that the method is inapplicable to most forests, as they cannot be expected to have so even a distribution and uniform rate of growth. It is, however, of academic interest, as it indicates the possibility of establishing a mathematical relationship between numbers of trees in different diameter classes at two consecutive measurements and the increments put on by trees of those diameter classes.

M. A. KAKASAI,
Forest Research Institute,
New Forest, Dehra Dun, India.

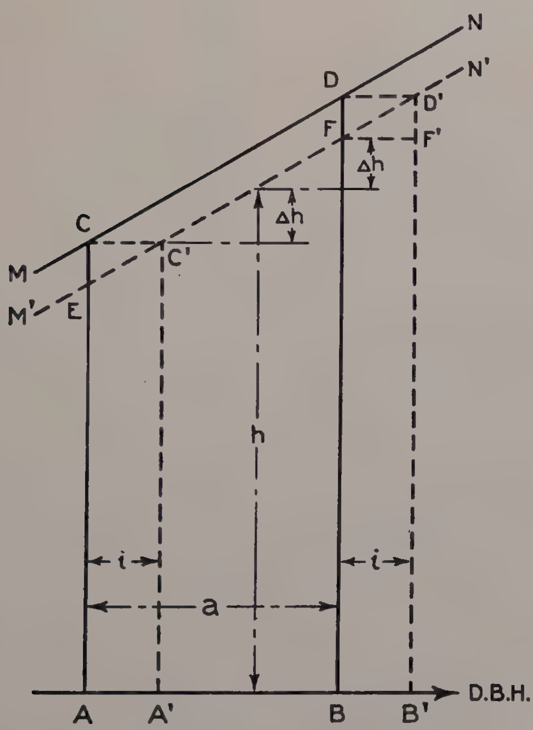

Fig. 2.—Reproduction of Meyer's Figure 2 (Jour. For: 33:804). The area ABDC represents the number of trees in the diameter class AB, and A′B′D′C′ the number after the increment represented by *i* has taken place. For further explanation of the diagram see Meyer's article.

REVIEWS

Ecology and Life History of the Porcupine *(Erethizon epixanthum)* as Related to the Forests of Arizona and the Southwestern United States. By Walter P. Taylor. *Univ. of Arizona Bull. VI-5 (Biological Science Bull. 3) 177 pp. Illus. 1935.*

Those who still hope for blanket yes or no answers to questions of pest-control will be disappointed in Walter Taylor's bulletin. It is, in my view, an extraordinarily complete demonstration of the fact that such answers are usually, by their very simplicity, spurious. Even to one whose daily business deals with the unravelling of complex ecological relationships, the reading of this work leaves a feeling of astonishment that so simple an animal as the porcupine should be involved in such a multitude of interactions with his environment.

The bulletin is more than a competent life-history study; it is an elaboration of the new concept of "animal weeds." Just as destructive land use seems to give a competitive advantage to "worthless" plants, so also does it seem to encourage abnormal abundance of troublesome animals. Both seem to be associated with a retrogression in the plant succession and a decline in that stored-up ecological energy which, in agriculture, we call fertility, in forestry site-quality, and in wildlife productivity.

The animal weed theory had its origin on the Santa Rita Range Reserve in Arizona, as a possible explanation of the dominance of jackrabbits and other rodents.

Weed associations, however complex in their environmental adjustments, seem to be simpler in their composition as to species than the associations which they replace. The weed is often a member of the preexisting association, but in it occupies a circumscribed niche. It is the process of resource-exploitation which presents weeds with the opportunity for dominance. It may reflect some profound intuitive understanding when we automatically resent the dominance of weeds. (These speculations are not the author's, but my own.)

In the Southwest overgrazing is suspected to be the underlying "cause" of too many porcupines.

Like all good jobs, Taylor's work raises more questions than it answers. Just how effective is the mountain lion as a porcupine-control? What is the role of the porcupine as a consumer of and at the same time a vector for mistletoe? To what extent does the porcupine delimit the lower edge of the timber type? Are porcupine gnawings a cause, or an effect, of bark beetle attacks? To these and many other queries, Taylor adds new data and fresh interest, but not final answers.

No life history, however well rounded, is devoid of weak spots. One of the weak spots in this one is, I think, the treatment of population cycles. A cyclic rise in porcupines is postulated as a possible alternative for the weed theory, but the discussion does not dig very deep. Historical data on past fluctuations in abundance are naturally scarce, but it seems at least thinkable that ring-counts of calluses on old gnawings might have yielded evidence of fluctuation. However, such counts would admittedly be very laborious. There is no discussion of the inherent probability

of cycles in porcupine. In my opinion the animal's coarse vegetable dietary and freedom from starvation losses would indicate a probability of cyclic behavior. It is in such animals that the cycle is usually prominent.

One wishes that the study might have included some banding to check against the interesting circumstantial evidence on seasonal migration.

The author seems to have tripped up on one minor question of fact: he asserts that "the porcupine has a slower breeding rate than any other mammal in North America, so far as known." The breeding age is two years; the number of young per year is one. The breeding index is thus 2:1. The black bear, however, is slower. The breeding age, according to Seton, is three or four years and the litter one to four, average two, but *litters are born only in alternate years.* The breeding index on this basis is, at fastest:

$$3:\frac{2}{2}, \text{ or } 3:1,$$

a slower rate than porcupine. Grizzly bears likewise have a 3:1 index, and possibly elk and buffalo. It is, I suppose, none too certain that the alternate-year postulate in bears is correct.

In discussing the recent reduction in mountain lions as a possible reason for porcupine increase, the author consistently ascribes it to "hunting for sport . . . and as a protection to the stock industry." If this implies an order of importance, I would take issue. Excessive reductions in lions have more commonly followed Biological Survey predator-control than sport-hunting. Elliott Barker, State Game Warden of New Mexico, has recently suggested that the way to put lions on moderate-density sustained-yield basis is to withdraw government control entirely, and put the whole job on a sport basis. Barker points out that motorized dog-packs now give the sport-hunter sufficient mobility to cover the lion range, and that the "law of diminishing returns" operates more promptly on sportsmen than on paid hunters.

By and large, we may confidently add Taylor's Porcupine to that growing list of first-rate ecological life-histories which constitute the foundations for wildlife management.

ALDO LEOPOLD,
University of Wisconsin.

A History of Lumbering in Maine 1820-1861. By Richard G. Wood. *Univ. of Maine Studies, Second Series, No. 33. The Maine Bulletin. Vol. 37, No. 7. 267 pp. Illus. 1935.*

Wood has compiled information gathered from a great many widely scattered sources — contemporary newspapers and periodicals, manuscripts, and public documents—into an interesting narrative of Maine's lumber industry from the year of attaining statehood to the year when white pine ceased to be the dominant species in the state's lumber output.

After reading his account of the reckless disposal of the public lands by Massachusetts and by Maine, of the hectic speculation in timberlands, especially during the 1830's, and of the progress of lumbering, the reader may wonder why Maine's forests escaped the fate that befell those of Michigan, Wisconsin, and Minnesota. The difference is the more striking when one considers that a great deal of the forest land of the Lake states was cut over by men who had made their start in the forests of Maine.

It is interesting to learn that Maine was supplying Boston and other Massachusetts cities with fuelwood by 1750, and was shipping lumber to New Orleans by 1820, to California in 1849, and to Australia by 1861. More unexpected, perhaps, is the information that Maine industries were importing oak and yellow

pine from the South in the 1850's and shiptimbers from Ohio and southern Michigan before 1860.

The book closes with a chapter on the emigration of Maine lumbermen to other forest regions, and a 27-page bibliography.

W. N. SPARHAWK,
U. S. Forest Service.

Tree Flowers of Forest, Park, and Stream. By Walter E. Rogers. *500 pp. Illus. Published by the Author. Appleton, Wisconsin. 1935. Price, $7.50.*

The surname Rogers is one to conjure with in dendrological literature. Julia Ellen's popular tree books are familiar to everyone, while C. C.'s works on conifers and Charles S.'s on the trees of Trinidad are favorably known to scholars. Now comes a distinctly new type, from the pen of Professor Walter E., who is the head of the department of botany in Lawrence College, Wisc., one of the oldest institutions of higher learning in the Middle West. In his introduction the author expresses gratitude to numerous individuals for aid in his work, including Mr. S. F. Shattuck "who, by his generous financial support, has made it possible to take the book to press."

This handsome volume, 8½" x 10½" x 1¾", is substantially bound in blue ("Terek Homespun") linen with an attractive cover design, in silver, of sugar maple, by Olga A. Smith, instructor in botany in Lawrence College. Very special attention has evidently been paid to the paper and typography. The book is profusely illustrated, containing, besides the author's 121 full-page half-tones, 314 marginal drawings and 121 full-page silhouettes by Miss Olga Smith. While there is brief textual material, in 2½-inch columns, on each species, the work is, as the author states, essentially pictorial and has as its two-fold objective: (1) familiarizing the reader with tree flowers and, more especially, with the form and beauty of the more minute portions of those organs, and (2) stimulation of the scientific and aesthetic appreciation of trees as individual components of the winter landscape.

The half-tones, executed in duotone green, developed as a result of special studies by the author, are probably the most remarkable single feature of the book. Most of them are photomicrographs, up to 20 or 30 times natural size, of the flowers, fruits, or buds of the 72 tree species described in the text, although a considerable number are in approximately natural size and show the entire inflorescence or a flowering spray. These photographs are not only valuable and informing from a purely botanical standpoint, but many have great artistic excellence. Among the most outstanding of these are the approximately natural-size plates of butternut, slippery elm, black locust, bladdernut, mountain maple, and common catalpa. Of the photomicrographs, many are of such originality and elegance of form as to appeal to students of design; among such may be mentioned the opened fruit of willow, the pistillate flowers of black walnut and chestnut, the staminate flower of silver maple, the winter buds of red maple, and the flowers of Ohio buckeye and sourwood. With the exception of ginkgo, European larch, Norway maple, sycamore maple, and horsechestnut, all the half-tones represent species native to the northeastern states. In addition to these, 12 other tree species are represented by winter silhouette drawings only, of which 4 are exotic introduced species, viz: copper beech, English elm, Lombardy poplar, and tree-of-heaven (ailanthus). The book concludes with separate indices, by common and scientific names.

In a book of so much worth and aesthetic appeal it appears captious to raise any criticism. In view of the great expense and pains taken with this work, it seems regrettable that a little extra care was not taken with the nomenclature (especially the English nomenclature), the arrangement, and the English index. By way of illustration, although "laurel" is already one of the most abused and misused of all English tree names, "great laurel" is here the accepted English name for *Rhododendron maximum; Larix decidua,* the European larch, is designated simply as "larch"; sugar maple, so called in the text, is "hard maple" in the headings. Special emphasis is paid in the book to maples, 81 pages being devoted to that genus; it would have been preferable to put the material on each maple species together, without interruptions of other species.

In certain genera (such as willow and hawthorn) only the genus appears in the heading; in such headings as "*Salix* sp. (Tourn.) L." and "*Crataegus* sp. L.", either the abbreviation "sp." or the authors should, of course, have been omitted. No cross-references and no indication as to preferences in usage are shown in the English name index. This gives rise to considerable apparently unnecessary repetition. The index (p. 485) refers to a "winter outline" silhouette of "rock elm" and also of "cork elm" on p. 197 of the text. Turning to p. 197 one finds a silhouette of "cork elm," without any reference to the name "rock elm." The reader is left to guess whether cork and rock elm are one and the same species and as to what their proper Latin name may be.

It seems a pity that botanists, a notoriously impecunious folk, should be compelled, bibliographically, to enact the role of King Tantalus, surrounded by books written for them but which they cannot afford to buy.

W. A. DAYTON,
U. S. Forest Service.

Governmental Problems in Wild Life Conservation. By Robert H. Connery. *Studies in History, Economics, and Public Law No. 411. 250 pp. Columbia University Press, New York, 1935. Price, $3.25.*

When someone who is neither a sportsman, nor a biologist, nor an administrator undertakes to write a book about wildlife conservation, it should pique the curiosity of all who bear one or more of these labels. Dr. Connery tells us nothing about himself except that he teaches government in Columbia, but his book supplies the missing information. He handles his conservation law and economics with competent lucidity, seems to have an adequate grasp of administration, is no sportsman (and does not need to be), but I cannot escape the conviction that his biology is of the previous century.

As a consequence of this unbalanced equipment, the outstanding value of the book lies in the parts which do not hinge upon biological interpretation, especially the first four chapters on land economics and conservation law. I do not recall any equally clear or complete analysis of the legislative history of wildlife. ("Wild Game—Its Legal Status" was equally clear on legal theory, but included no history. Palmer's "Chronology of American Game Protection" included much history but no legal theory.) This section of the book alone gives it a high value to the serious student as a reference work.

The succeeding chapter on the Biological Survey lacks color and discrimination. It is all too evidently "as told to the author" by the staff of that Bureau. A truly critical appraisal would have been more valuable to the Survey, as well as to the reader. The nearest approach to a critique is the statement that "during most of its history, the Survey has not been particularly aggressive in undertaking wildlife conservation measures." The various divisions and proj-

ects of the Survey are described in the manner of its own familiar "Annual Report," those of weak accomplishment being indistinguishable from those which have helped write scientific history. For example, the animal-disease project at Minnesota, which I think would rate in the latter category, is barely mentioned.

A chapter on the Bureau of Fisheries follows, but this I will not discuss for lack of competence to do so.

Dr. Connery comes back into his own in his chapter on reorganization of federal conservation bureaus. He displays a healthy skepticism about all the "plans" so far proposed. Shoving bureaus around, he says, merely creates a new crop of borderline cases and demoralizes work. Coordination, he thinks, can and must be built up, even without reorganization. He implies that coordination depends on people rather than blueprints. With these sane views the reviewer heartily agrees.

The chapter on state departments gives an adequate sketch of legal theory and organization, but fails to mention the central issue: Is the state conserving wildlife, or helping its landholders to do so? The author, by inference, accepts the former view. But what about the uncomfortable fact that the former view has failed to conserve wildlife, except in those states where economic accident has kept food and cover in a favorable condition?

There is no mention of the pressing problem of state administration of game on federal properties such as the National Forests. A review of this issue by a disinterested student of government would have been particularly welcome.

There is a meaty discussion of law enforcement, couched in terms of illustrative "cases." It begins with an apt quotation from that patron saint of poachers, Robin Hood. The author tracks down the residual trouble to politically appointed district attorneys. The reviewer would like to share the author's optimism about the status of state and federal cooperation in migratory bird law enforcement.

By and large, Dr. Connery's book is a valuable record of the chain of logic open to a good mind well versed in law and government, but blind to ecology. There are ecological works listed in the bibliography, but they fail to register in the underlying thought of the text. The author conceives of wildlife as something which will grow if not destroyed. The ecologist conceives of wildlife as something which cannot be destroyed if the environment is favorable, but which will inevitably disappear if it is not. Manipulating environment is applied ecology, or cropping. The governmental machinery of conservation, built to police a resource, now finds itself called upon to crop it. Government, except on its own land, cannot crop anything. What to do?

This is certainly a "governmental problem in wildlife conservation." Its omission from this otherwise able work shows how long it may take before conservation emerges from its invisible empire of ideas, and becomes physically visible upon the American landscape.

ALDO LEOPOLD,
University of Wisconsin.

The Use and Misuse of Land. By R. MacLagan Gorrie. *Oxford Forestry Memoirs 19. 80 pp., 5 pl., 3 figs. Oxford University Press. 1935. Price, $2.*

Many foresters and other conservationists will pleasantly recall Dr. Gorrie's trip to this country for four months late in 1934 and early in 1935, as a Leverhulme Research Fellow.

This report is not the usual inadequate or one-sided description ordinarily expected from foreigners who make hurried visits to this country. Dr. Gorrie has done a remarkable job of assimilating

and drawing his own conclusions, considering the fact that he travelled about 4,375 miles per month. That he profited by the trip professionally is indicated by his recent promotion to the position of Deputy Conservator of Forests in India, in charge of Research. That our problems and the research and administrative attack being made upon them broadened his viewpoint is shown by the fact that his fellowship was awarded for the study of "The Correlation of Erosion Damage and Grazing in Forest Lands," whereas his final report deals with the whole broad field of land use. True, in such a hurried trip, he could take a sample only here and there, but the report considers wild lands, including both forest and range, and includes discussion of farm lands as viewed from the standpoint of erosion.

There is a minimum of those trivial errors which reviewers usually pounce upon.

It is good for us to see ourselves as others see us. Even more important, in this publication, is the running comment on how Dr. Gorrie's observations and conclusions here relate to the problems he has observed in twelve years with the Forest Service in India. Breadth of view is indicated throughout the eight chapters, a brief summary of which follows.

1. Forestry as a factor in land management. Forestry is treated as a part of the whole land problem in the United States, using the Eldorado County[1] study as a specific example.

2. Grazing and range management. The development of range surveys and systems of management in this country are concisely presented, the central idea being that numbers of livestock must be based upon the true grazing capacity of the range regardless of whether it is in the western United States or in the foothills surrounding a Hindu village where religious beliefs interfere with the reduction of cattle.

3. Overgrazing as a primary cause of soil erosion. This deals with normal erosion versus accelerated erosion, cites two extreme examples of severe erosion caused by overgrazing—one from Punjab and one from the Navajo Reservation,—and shows the importance of vegetation and its proper use in controlling erosion, as brought out by Forsling's study on the Wasatch Plateau.[2]

4. Value of vegetational cover in stream-flow control. This is a good picture of our western irrigation situation, particularly the existing dangers from floods and silting of reservoirs. The importance of plant cover in run-off control is emphasized, with specific descriptions and data from the San Dimas Experimental Forest in southern California, and from several other parts of the country. Promoters of irrigation developments in British countries are cautioned to bring about proper land use as a safeguard against silting of reservoirs.

5. Forestry as a factor in farm and village economy. Unfortunate land practices in Africa and southern Asia are compared with our own submarginal farm problem, and the advantages to the community of properly managed woodlands are pointed out.

6. Farm erosion and its control. Ten pages are devoted to a summary of farm erosion in this country and the methods being followed to overcome it.

7. Other examples of the misuse of land. This includes smelter fume damage, hydraulic mining damage, and road erosion.

8. Public and private control of land. Here is clearly recognized the necessity

[1]Weeks, D., A. E. Wieslander, and C. L. Hill. Utilization of Eldorado County land. Univ. of Calif. Agric. Exp. Sta. Bull. 572. 1934.

[2]Forsling, C. L. Study of influence of herbaceous plant cover on run-off and erosion in relation to grazing. U. S. Dept. Agric. Bull. 220. 1931.

for public ownership of lands with high public values, and the necessity for a technically trained public organization to secure application of the multiple-use principle of land management.

There is a bibliography at the end of each chapter.

The volume is well worth reading.

R. S. Campbell,
U. S. Forest Service.

The Spruce Budworm on Michigan Pine. By Samuel A. Graham. *Univ. of Michigan School of Forestry and Conservation Bull. 6. 56 pp., 8 figs. 1935.*

The spruce budworm (*Harmologa fumiferana*) is usually thought of in connection with the tremendous damage done to the spruce-balsam forests of eastern Canada and New England. It later appeared in epidemic form in the West, where whole mountain sides of Douglas fir were killed and various species of true firs were attacked.

Between 1922 and 1924 the budworm was found attacking various species of pine. From time to time since 1923, when it was first reported on jack pine, it has been locally injurious throughout the Great Lakes region. Jack pine has been rapidly increasing in abundance on cut-over lands, and this factor has probably influenced the increase of the budworm. In 1930 it was especially abundant in the jack pine forests of northern Michigan. The insect, although taxonomically identical with the spruce-fir form, is biologically distinct. Rarely, even when hard pressed, will larvae of the pine form transfer to balsam. The two forms can therefore, from a control standpoint, be treated as if they were separate species.

Outbreaks first appear as spot infestations. Defoliation is usually heaviest at the top of the tree. This often results in formation of a stag head. Complete defoliation may result in death if repeated. Large trees are not often killed. The larvae also feed on the flowers and thus reduce the seed crop. The heaviest infestations occur in stands of large-crowned trees, for such trees have an abundance of staminate flowers on which the young larvae thrive. Scotch pine is the most susceptible pine, and outbreaks will build up in plantations of this species regardless of flowers.

Control can be accomplished by removing the more susceptible trees, maintaining dense stands, and logging jack pine before it becomes overmature.

H. B. Peirson,
Maine Forest Service.

Relative Efficiency of Roots and Tops of Plants in Protecting the Soil from Erosion. By Joseph Kramer and J. E. Weaver. *Nebraska Univ. Conservation and Survey Division, Conservation Dept. Bull. 12. 94 pp. 1936.*

In this timely bulletin the authors have made a valuable contribution to existing knowledge of the role of plants and plant parts in controlling or modifying soil erosion. Several of their conclusions have direct application to forestry operations, particularly where soil protection is an important phase.

As the title suggests, the investigation is concerned mostly with the problem of relative effectiveness in soil protection of the entire plant, as compared with the roots alone. A large number of field, pasture, and garden crops as well as native grasses and weeds were studied. The procedure consisted of the following: (a) encasing, intact, one-half square meter areas of soil 10 cm. deep, in which were growing plants in various stages of development; (b) clipping the plants at the

surface in one set of samples, leaving a duplicate set intact; and (c) noting the time and nature of soil washing when exposed to a stream of water from a hose. Suitable checks of bare soil were similarly treated.

The results were in part as follows. It is obvious that the plant parts above ground are much more effective than those below, "although the soil is also held in a remarkable manner by the roots and rhizomes." Naturally the structure or expanse of the stem and leaves and their duration and the density of the stand determine the relative value of the different plants. Roots and tops of many cultivated plants were more than seven times as effective as roots alone in checking erosion. Many plants when prostrate, as in winter condition, are as effective as when erect. Loose, bare soil resisted erosion only 17 minutes, but with a three-weeks growth of grass erosion time was extended to more than 12 hours. It is obviously important that the *soil surface* be protected, so as to provide actual physical impedence to surface washing. The most efficient protection was afforded by native prairie grasses. Slough grass, for example, resisted a pouring rain for a period of 24 hours with scarcely any loss of soil.

Several applications of these findings to the field of forestry are suggested or inferred. On planting sites needing soil protection, herbaceous cover throughout the year is necessary until the trees form a closed canopy or produce sufficient duff to cover the soil. For maximum protection the duff or herbaceous cover must be retained permanently. Shallow-rooted trees, shrubs, or herbs assist in protecting the soil surface; deep-rooted trees have negligible effect. Obviously fire, overgrazing, or any other circumstances which destroy the surface-protecting materials are undesirable.

LEWIS M. TURNER,
University of Arkansas.

Soils of the United States. (Atlas of American Agriculture—Part III.) By C. F. Marbut. *98 pp., 8 pl., 57 figs. Government Printing Office, Washington, 1935. Price, $5.*

This comprehensive resumé of the soil survey work that has been done by the U. S. Department of Agriculture in co-operation with most of the states, under the guidance of the late Dr. Marbut, is a most welcome analysis and clarification of what tends to be an imposing complexity because of the multiplicity of soil series and types that have been recognized in the United States.

For any one interested in a single county, a soil survey of that county is a relatively satisfactory account of the soils, their location, and their agricultural utilization. As the area of one's interest becomes larger, however, and approaches that of a forest region where more than one state is involved, the many soil series and types, sometimes difficult to correlate between different states, become less and less satisfactory. This publication is a much needed step in the direction of combining the many small units into categories of higher order and wider significance. The situation is closely analogous to that of forest types. In any one locality, a forester will readily recognize a number of distinguishable forest types, but if all such types in each unit of area as small as a county are enumerated, the confusion for a forest region or for the country as a whole becomes imposing. Broader groupings are essential for use when large areas are involved. The broader groupings for the soils are equally needful, and for the same reasons.

Unfortunately, the soil surveys have been largely confined to agricultural lands, and, as the text states, "In the mountainous parts of the country . . . large areas have not yet been mapped. . . . In such areas the soil map is based on very general information." Another point

is worth quoting, as it bears upon the relation between the distribution of soils and that of forest vegetation. The soil maps have been constructed on the basis of soil characteristics and "not on inferences derived from a consideration of climate, vegetation, or other feature of the natural environment." Hence this independent study of the soils permits a much more valuable correlation with similarly independent data on forest distribution.

The Atlas includes the following maps, most of them in color: the detailed projects covered by the soil surveys to January, 1934; the great soil groups or soil provinces; the distribution of parent materials; the distribution of groups of soil series in geographical subdivisions of the country; the relative reliability of the soil survey data; and the distribution of soils without normal profiles. Appropriate text and illustrations accompany and supplement the maps.

The 15 mapped soil provinces for the country as a whole are based upon the Great Soil Groups of the Russian School. However, the prairie chernozem, dark brown, and gray desert soils are subdivided into northern and southern divisions in each instance, and groups have also been added which are termed "Pacific valley soils," "mountain areas," and "sand hills of Nebraska." Representative profiles of these provinces are illustrated by colored plates, accompanied by analytical data as to their composition. Results of analyses of the horizons of typical soil types from each group are also presented.

The attempt to bridge the gap between these broad provinces and the many soil series is made, first, by combining series having certain characteristics in common into a group which is given the name of its most important member. For the whole country, 213 of these groups are differentiated and mapped. A question may be raised whether this use of the same name for two different orders in the scheme of classification will not lead to confusion.

Another order of subdivision for the soils without normal profiles includes six categories, namely, soils with imperfectly developed profiles, with claypan, with indurated hardpan, and with young profiles due to lime, to poor drainage, or to mountainous topography. Several of these sub-groups are represented in only one or a few of the provinces, and hence may not afford a wholly satisfactory order of classification by which one might proceed logically from the province to the series, or in the opposite direction. The soils of steep slopes and rocky and mountainous areas are combined in three or four categories which must contain extremely diverse elements. From the forester's point of view, this beginning still leaves something to be desired in the classification of soils of forested mountain lands. Considering their complexity and the limited study which has been given to such soils, this is doubtless all that could be done under the circumstances. But it may be hoped that the excellent beginning made by Dr. Marbut will lead to further study and elaboration or definition of these categories in the scheme of classification.

The text also includes the methods of analysis used by the Bureau of Chemistry and Soils; a discussion of soil development with data for molecular ratios and pH by types, horizons, and groups; and graphs of the chemical and mechanical composition of profiles for typical types. A list of 194 titles of pedological literature is included.

Admitting that much remains to be done on the soils of forested areas, this Part III of the Atlas is a valuable contribution for every forester who is interested in soils.

Joseph Kittredge, Jr.,
University of California.

CORRESPONDENCE

Editor, JOURNAL:

Kittredge's article on page 417 of the April JOURNAL was, to me, very interesting and instructive. I have a real interest in tree transpiration and appreciate any attempt to uncover the true picture regarding total transpiration from forests. Thus, I would like to make a few comments on this article. He states that a 40-year-old forest will use 12 inches of water annually. I assume this figure is intended to be merely an estimate, as the source of information and the character of the forest is not given. Data as yet unpublished indicate that a 50 to 60 year old beech-maple Adirondack forest on soil of about 35 per cent total moisture uses between 4 and 5 inches of water annually. This is assuming 350 trees per acre, which is probably high. It is certain, however, that certain types of bottomland forests use considerably more than 12 inches of water.

Another and perhaps more serious error is the assumption that transpiration varies directly with foliage density. This overlooks the well established effect of solar radiation on transpiration. For example, the transpiration of tree seedlings exposed to full sunlight was 7 to 8 times as great as that from similar seedlings under a forest canopy. A beech branch on the periphery of the crown transpired twice as much as the average for all branches not on the extreme periphery. It is evident that a crown density of 0.4 would transpire much more than half of that from one of 0.8.

It is to be hoped that in a few years sufficient quantitative data will be available to take this subject of tree and forest transpiration out of the realm of guesswork and into the folds of science, where it belongs.

LEON S. MINCKLER,
U. S. Forest Service,
Woodward, Okla.

MORE ON THE WILDERNESS

The JOURNAL welcomes the following thoughtful letter from a member of the Society who holds the position of Naturalist in the National Park Service.

Editor, JOURNAL:

I have read two editorials on wilderness in recent numbers of the JOURNAL OF FORESTRY which are so original that they quite took me by surprise, and left me gasping for breath. My own feelings about wilderness are different in many respects from the editorials; they are more in line with the comments on the December editorial made in the letters of Aldo Leopold, Robert Marshall, and Lincoln Ellison which appeared in the April issue of the JOURNAL.

It seems to me that the editorials present an inadequate conception of what it is in a wilderness that people experience. To evaluate wilderness, as the editorials have done, by a beauty whose standards are best measurable by trained "artists and critics" is really superficial. If beauty is the term used to describe the essence of wilderness, then it must be recognized as a type of beauty which is capable of being felt by souls in all walks of life.

Rather than speak of the beauty I prefer to speak of the spirit or feeling of

wilderness. The elusive and intangible qualities of it seem better expressed by these terms. Beauty there is in any natural area, but the feeling we get from wilderness does not depend primarily on beauty but upon the absence of human occupation and upon space. The more space, the deeper does the wilderness spirit become, and the more color is given to an experience and adventure in it. Each wilderness has its own regional spirit, and within it many lesser spirits.

The April editorial seems to doubt that human interference can greatly harm the aesthetic appreciation or the scientific value of wilderness. The first value is directly proportional to human interference. Each invasion harms it, until a point is reached where its wilderness aesthetic value is completely destroyed. The blemish a wilderness receives from the activities of man is much the same as that inflicted on an old Chinese jade carving when touched up by a modern workman. The image might be improved, but the value of the carving would be greatly diminished — it is no longer genuine.

The scientific value of a wilderness "biotic complex" lies solely in its being left in an undisturbed state. Any intrusion, however slight, injects an uncertainty into the natural experiment. From that time on we are in doubt as to the effects of the human disturbance, for we know too little about ecology to make the proper allowances. The value of a perfectly undisturbed area rests in the fact that we know it represents the result of natural factors. And may I point out here that an area must be of good size to preserve a natural state, for the smaller the area the more greatly is it influenced by factors outside of it.

The editorial states that love of wilderness is a recently acquired taste. The discussion given does not sound at all convincing, but the subject is far too involved to discuss at any length without extensive research, both into the past and present. However, I wish to remark that I have found many individuals who were affected by nineteenth century romanticism only very indirectly, if at all, who had a spontaneous appreciation of wilderness. I once was in the Endicott Mountains in Alaska with an Eskimo who frequently remarked about the enjoyment of the wildness of the region. He recognized that intangible quality of unpopulated places without having had training.

I am wondering how "our good old doctrine of obtaining, through wise use, the largest measure of contribution to the welfare of everybody in the long run" is going to be used in the disposition of our wilderness areas. There is chance to go wrong here. Whom does a wilderness benefit? Only him who enters it? I think probably his neighbor benefits, probably gets a little inspiration secondhand. How many people have not been served by some great musician who drew his inspiration from aesthetics. E. T. Seton created a tremendous sympathy for wild animals, feelings which every mother would wish in her child, and Seton drew his material and inspiration from the wilderness. Many draw that which a wilderness supplies to a people from the literature, which must be fed.

I believe that many of us are benefited by the mere knowledge that wilderness exists. We would suffer a definite loss if suddenly we should learn that the jungles of South America had disappeared. Wilderness is a wholesome mental background for many of us. Stephen Leacock writes: "I never have gone to the James Bay; I never shall. But somehow I'd feel lonely without it."

The wilderness benefits filter into our population in many ways, but the good is so intangible it probably will not be recognized by the land-planners. There is danger that the decisions will be based purely on economic and material values. But that's the Twentieth Century.

If there yet remained in the United States any appreciable amount of wilderness, we might have occasion to worry about over-emphasis of its values. But with the relatively small amount of it yet with us, and in view of the rapidity with which it is disappearing, the danger seems to lie rather in an under-emphasis of wilderness values.

ADOLPH MURIE,
Jackson, Wyo.

A CONSTITUTION SESQUICENTENNIAL TREE PLANTING PROGRAM URGED

Editor, JOURNAL:

The American Tree Association scores again for trees and forests. Its founder and officers have a quick sense for seeing the value of important historical events as vehicles for making the public tree minded. The more of this the better for forestry. A regard for trees and the protection of forests cannot be forced on the public. There must be intelligent interest and understanding first. The Association has already done much to further these essentials.

In 1932 the Association attached a tree-planting program to the Washington Bicentennial celebration with noteworthy success. In 1937 it will do the same with the Sesquicentennial aniversary of the writing of the Constitution. Already the Association has issued a booklet and a complete plan for its program. The booklet itself is a valuable contribution. It contains the text of the Constitution with Amendments, and some facts pertaining to its adoption. Many a household, through this booklet, will have its first copy of our Constitution and many people will read that document for the first time.

Foresters will do well to give the American Tree Association's program full support. I suggest that foresters through their children get action from nature study teachers. They can also do something to get local communities into the mood for planting up some waste lands as Constitution Groves or Parks for the future enjoyment and inspiration of their citizens. Such plantings may also take the form of large-scale forest establishment programs. But whether forests or recreation areas, whatever is planted will arouse more interest in trees. Properly labelled, the trees and groves will be long-time reminders.

EMANUEL FRITZ,
University of California.

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